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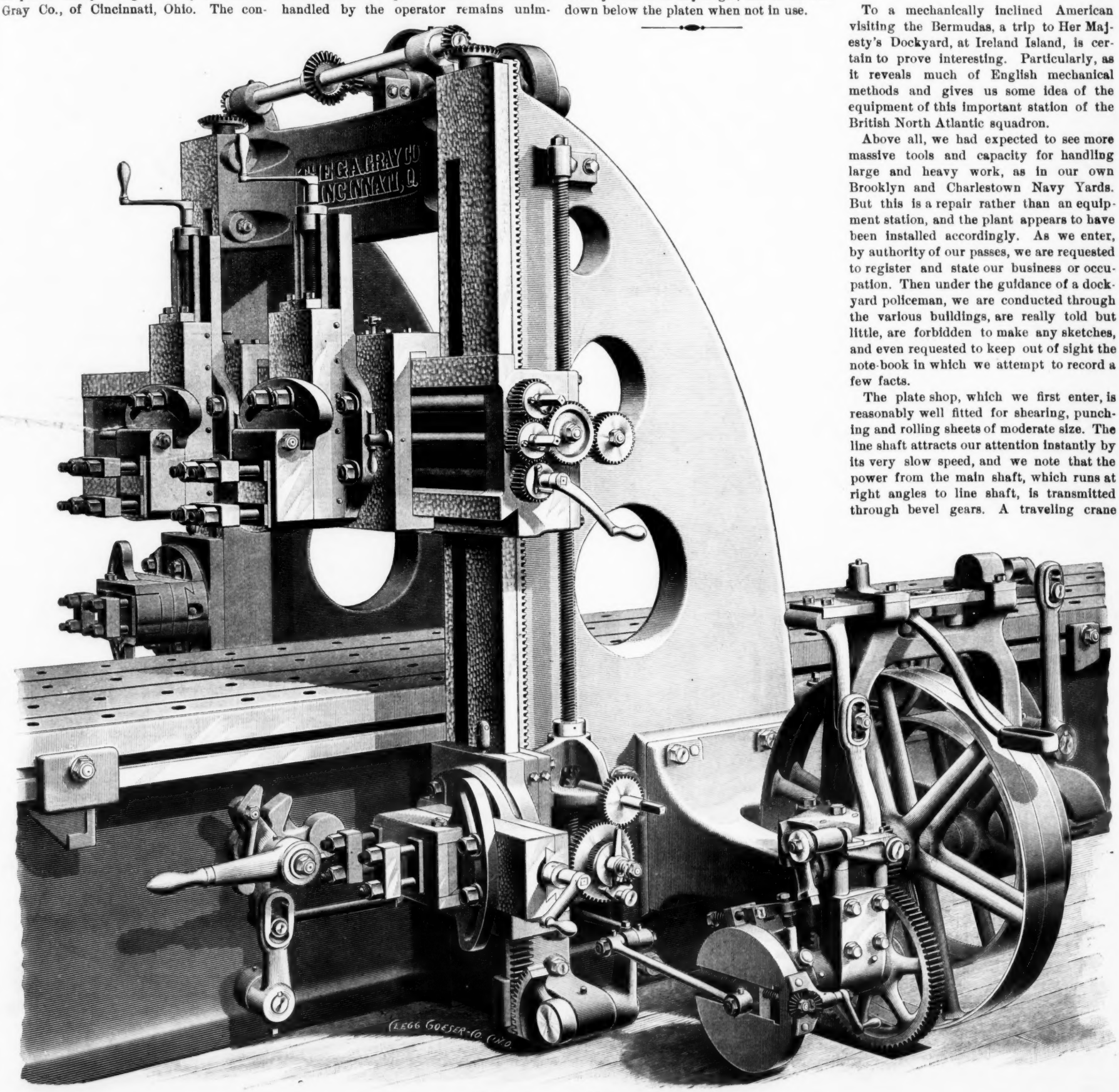
Metal Planing Machine.

The accompanying cut represents a type of planer lately brought out by The G. A. Gray Co., of Cincinnati, Ohio. The construction is such that the machine may be built with left-hand upright extended to take in any desired width—within certain limits—at a very small additional cost of construction, thus providing for a large range of work with a comparatively small planer. By this arrangement the front side of the machine is not disturbed, and the convenience of parts which are to be handled by the operator remains unimpaired. The cross rail is in each case designed to suit the increased space, the box bracing on the back being proportionately increased in its cross-section.

The driving and feeding mechanisms, which have been described in former issues of this paper, are set well back, out of the way of the side heads, allowing them room for adjustment to any angle, and to be run down below the platen when not in use.



METAL PLANING MACHINE.

It is said that the P. R. R. proposes to abolish all grade crossings between Jersey City and Philadelphia. This would give an opportunity for Le Van's 90-minute train between these points.

Notes from the Bermudas.

BY WALTER B. SNOW.

To a mechanically inclined American visiting the Bermudas, a trip to Her Majesty's Dockyard, at Ireland Island, is certain to prove interesting. Particularly, as it reveals much of English mechanical methods and gives us some idea of the equipment of this important station of the British North Atlantic squadron.

Above all, we had expected to see more massive tools and capacity for handling large and heavy work, as in our own Brooklyn and Charlestown Navy Yards. But this is a repair rather than an equipment station, and the plant appears to have been installed accordingly. As we enter, by authority of our passes, we are requested to register and state our business or occupation. Then under the guidance of a dockyard policeman, we are conducted through the various buildings, are really told but little, are forbidden to make any sketches, and even requested to keep out of sight the note-book in which we attempt to record a few facts.

The plate shop, which we first enter, is reasonably well fitted for shearing, punching and rolling sheets of moderate size. The line shaft attracts our attention instantly by its very slow speed, and we note that the power from the main shaft, which runs at right angles to line shaft, is transmitted through bevel gears. A traveling crane serves to handle material in all parts of this shop.

In the foundry—a building of very moderate size—we find three cupolas, with provision for running a continuous heat and

producing a few castings of considerable weight, measured perhaps as much by the capacity of the overhead traveling crane, viz , 8 tons, as by anything else.

In the smith shop is to be seen only one steam hammer of very moderate size, the capacity of which could not be determined. Substantial wrought-iron forges line the sides of the shop, with large hoods discharging the smoke into chimneys built into the outside walls. A cumbrous blower of Lloyd's make furnishes the blast.

operating, condensing, under 45 pounds pressure and about 27 inches vacuum. Power is transmitted from the crank-shaft through bevel gears to the jack-shaft. It made one positively weary to stand and watch the snail-like operation.

The shops, well protected by the massive fortifications, are very attractive in their design and color, being constructed of the coral formed rock of the island. But the floors impress us more vividly, particularly in the machine shop, where we find a cob-

and at the gap would turn about six feet diameter. Small tools in ordinary variety complete the equipment. Nothing extraordinary in size or design and everything English, of course. We are informed that some 500 men are regularly employed in the shops, which includes carpenters, sail makers, riggers, and the like.

The wonder of the dockyard is, however, the massive floating dock, 381 feet long, 124 feet broad, and 74 feet deep. This was built in England, and towed across the

that when properly sunk and leveled, the largest ironclad can be floated in, the ends closed and tightly calked, and the water then pumped from the interior of the dock. In the case of vessels of moderate size the ends are not closed, for the removal of water from the compartments renders the entire structure sufficiently buoyant to raise the keel to the water level.

We are limited to about one and one-half hours for our visit, and consequently our inspection is cursory, and we are unable to

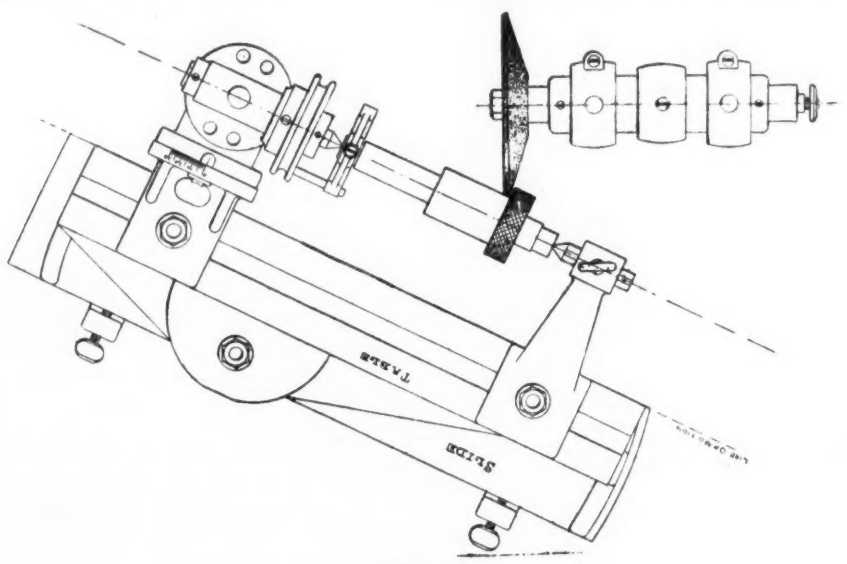


Fig. 9.

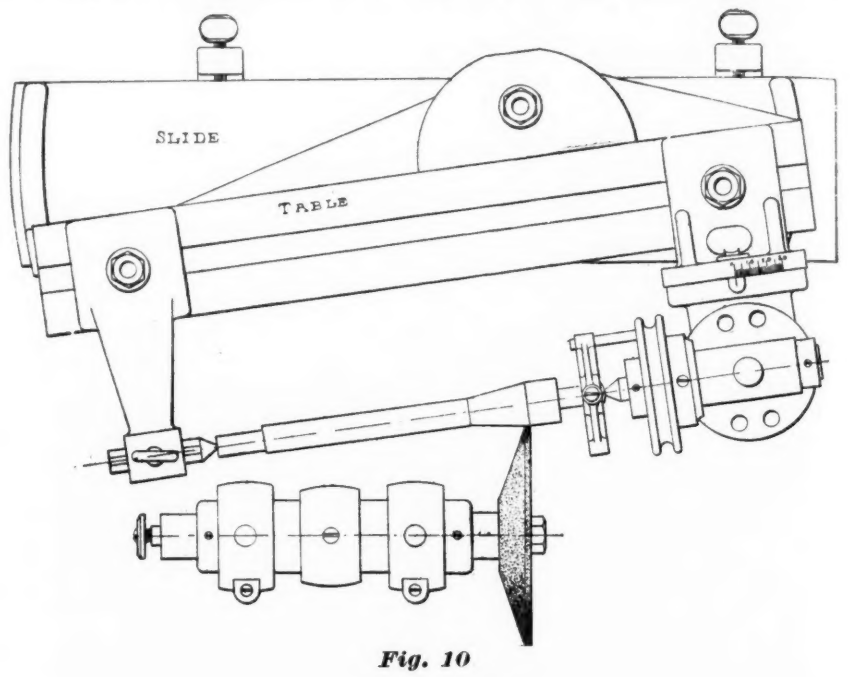


Fig. 10

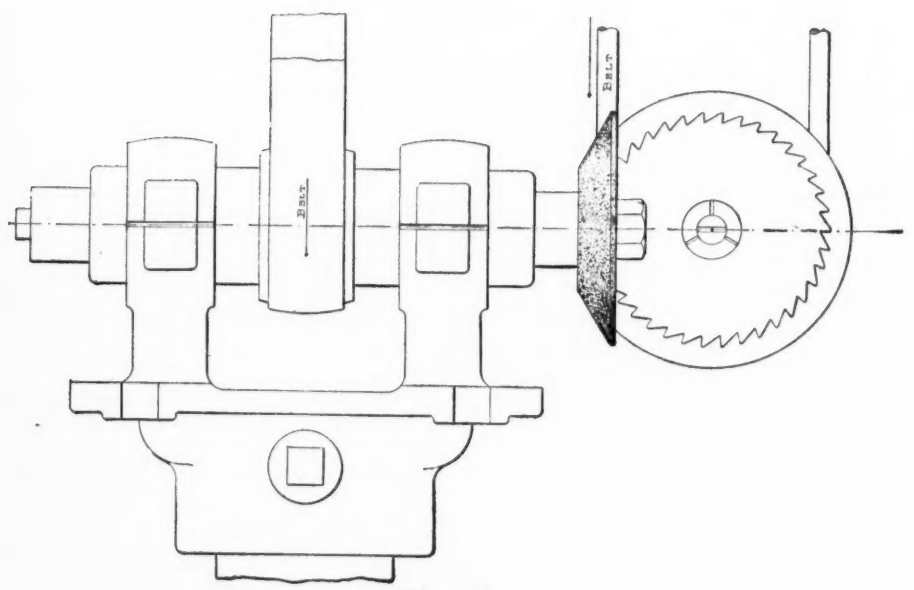


Fig. 11.

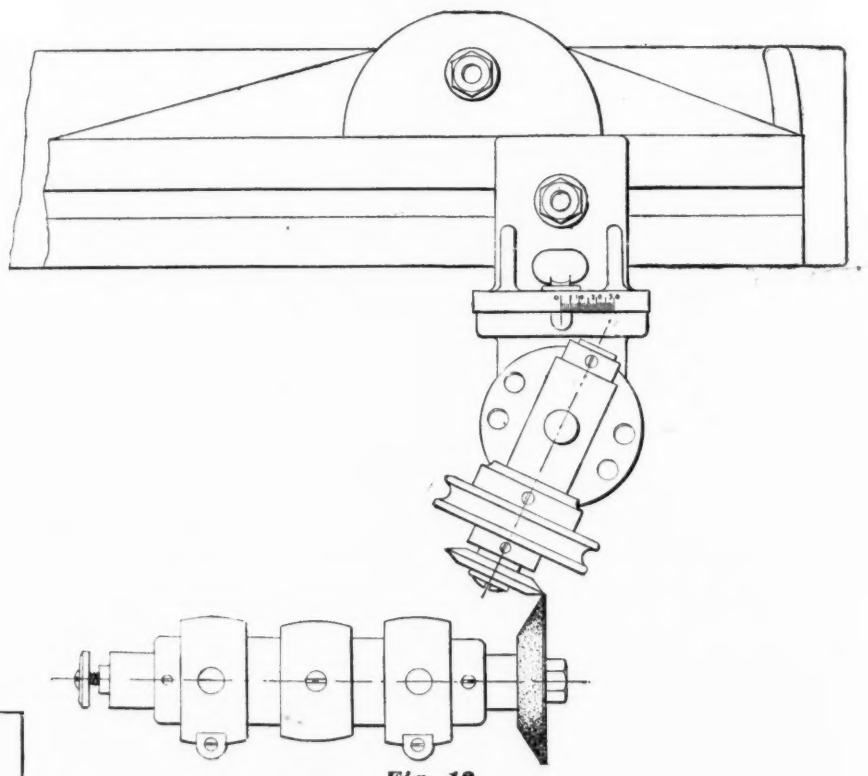


Fig. 12

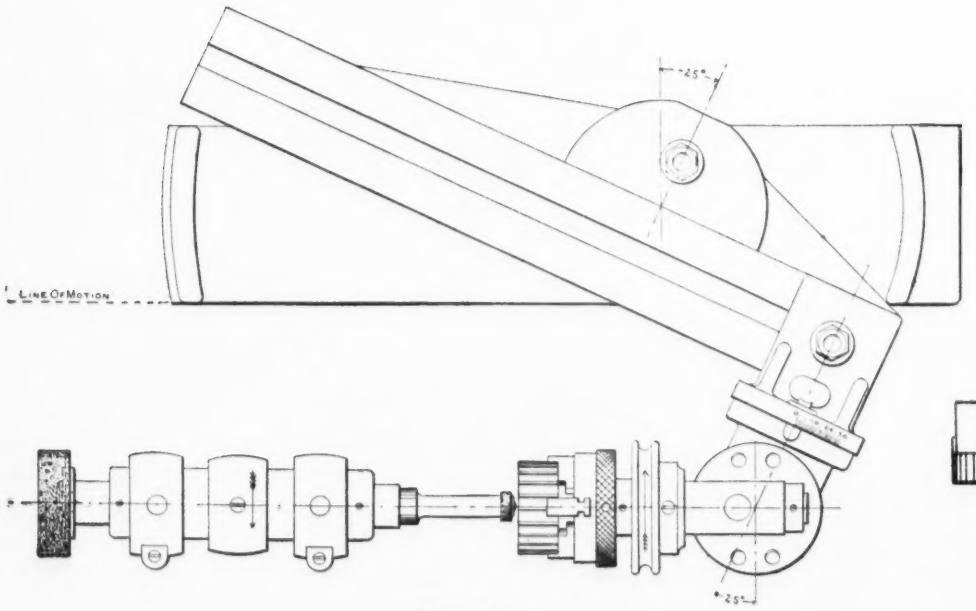


Fig. 13.

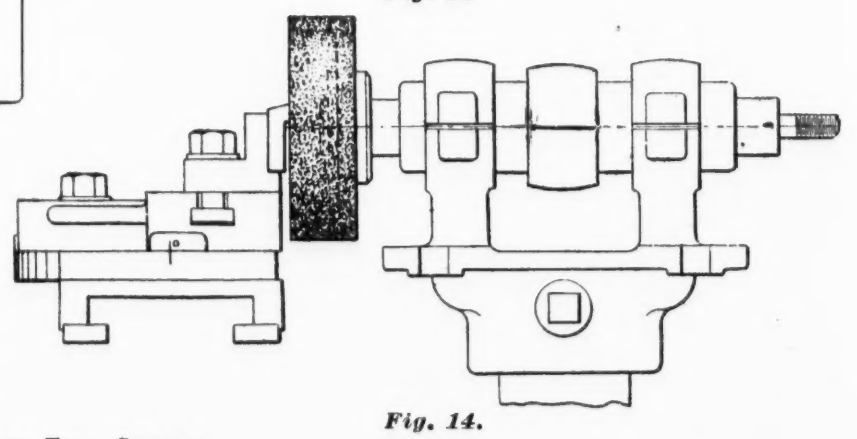


Fig. 14.

UNIVERSAL CUTTER AND TOOL GRINDER.

The motive power is, however, the source of greatest interest to us. This plant can scarcely be considered most modern in its design and operation, but it is most distinctly un-American. The engine, of antiquated beam type, with beam above, has a cylinder which we estimate as about 24 inches diameter by 42 inches stroke and is running at a speed of only 16 revolutions per minute. The gauges show that it is

ble stone arrangement worse than that of many city streets. The inconvenience of it is, however, somewhat avoided by a system of transfer cars and tracks and overhead traveling cranes. In this shop we see the largest planer in the yard, capable of planing only about five and one-half feet square, and the largest lathe, which by estimate—not by measurement, which was forbidden—would handle a shaft some 30 feet long

Atlantic to its present location It is constructed throughout of plate iron, the inner and outer shells being rigidly braced and united by an intricate system of cross plates and angle irons, forming 48 water-tight compartments. The entire structure is said to weigh 8,200 tons, and by the depth marks we see can be sunk 34 feet. Four steam pumps upon either side serve to fill the compartments, or empty them at will, so

obtain the information we desire. Nevertheless, we depart with the greatest of respect for the naval prowess of our English cousins, but still firm adherents to our American shop methods.

Universal Cutter and Tool Grinder—II.

Continuing from last week our description of the construction and method of

operation of the universal cutter and tool grinder made by the Cincinnati Milling Machine Company, Fig. 9 (page 2), represents the machine as arranged for grinding work revolved upon dead centers by a round belt. In this case the entire table is swung around the column simply to allow the wheel shown to grind close to the shoulder; but since the center line of work remains parallel to the slide the work produced is cylindrical.

In Fig. 10 the centers are shown set at an angle to the slide for grinding taper work, and when so set, the entire table with centers can be swung about the column to present the wheel to the work in the most favorable position without affecting the taper of the work.

Fig. 11 gives the method of grinding the sides of thin saws upon their sides, slightly hollow, a face-plate with taper bushing for holding the work being furnished for this. This face-plate is held on a taper arbor swivel vise as shown at Fig. 15, where a die is shown as being ground upon its upper face by a cup wheel.

At Fig. 16 the vise is shown swiveled for grinding a different job. All the swivels about the machine, including that on the vise, are graduated.

At Fig. 17 is shown a method of grinding gauges.

Metal tubes can be cut off smoothly and quickly by means of an emery wheel about $\frac{1}{16}$" thick as shown at Fig. 18, a brass tube 1" diameter having been cut off in this manner in 10 seconds.

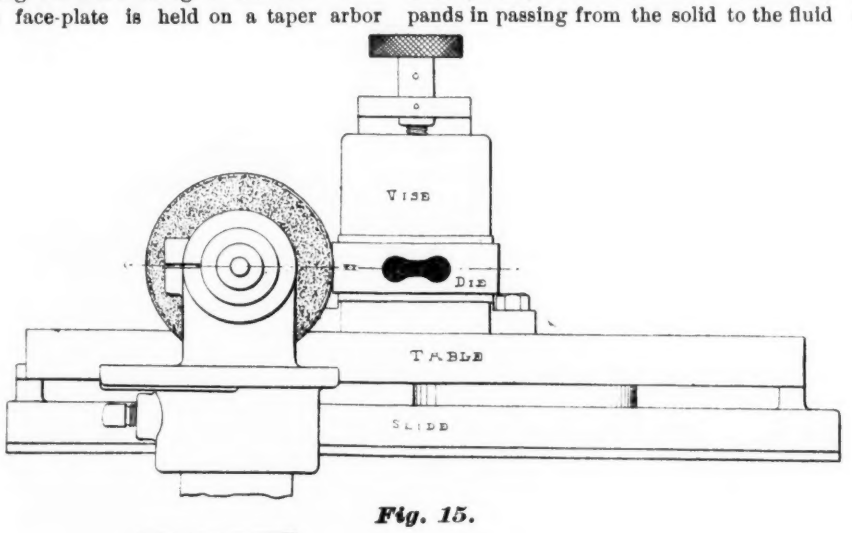


Fig. 15.

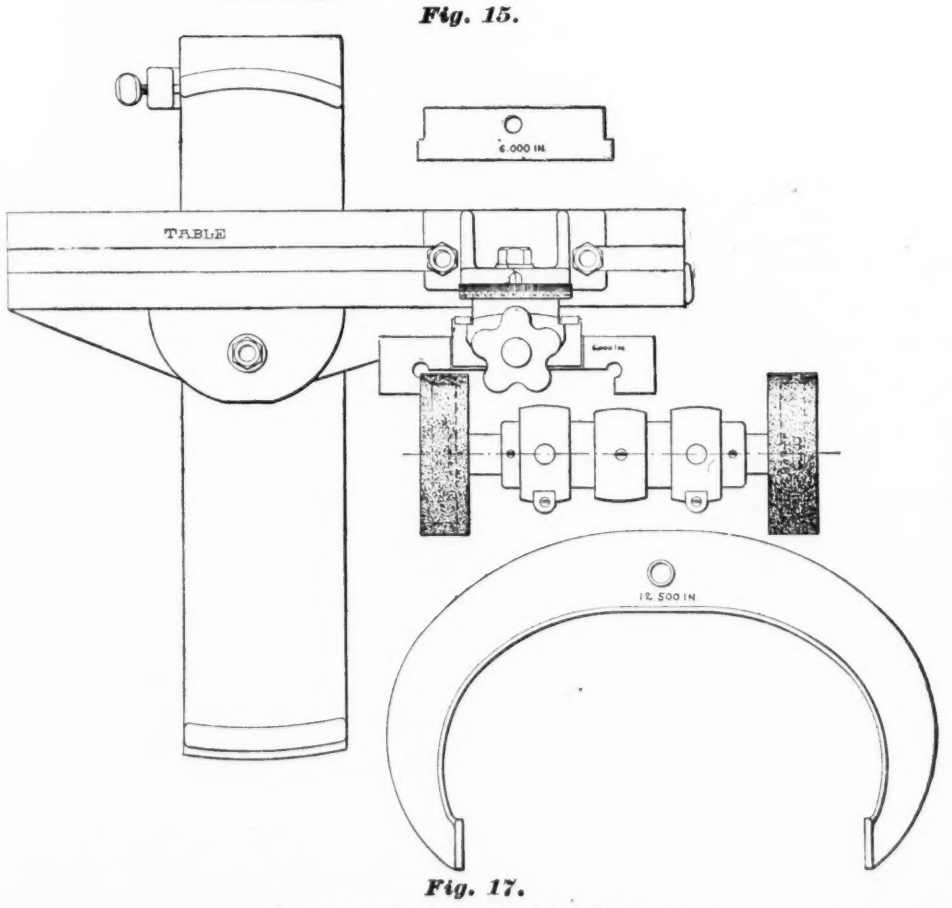


Fig. 17.

UNIVERSAL CUTTER AND TOOL GRINDER.

fitting into the cutter spindle, which is made to revolve by clamping the loose pulley to it.

At Fig. 12 is shown the method of grinding a slitting knife having beveled edges.

Fig. 13 illustrates the method for internal grinding, an extension spindle carrying a small emery wheel being screwed on main spindle. In order that the table may not strike the headstock it is set at an angle of about 25 degrees, and the swiveling head holding the work is set at the same angle in an opposite direction, to bring the work parallel with line of motion.

A shear plate, such as is used on lever shears for sheet metal, is being ground at Fig. 14, there being in this case a special fixture for holding the blade. A very large variety of similar work can, however, be ground upon the machine by being simply clamped direct to the table, or held in a

Comparative Density of Solid and Fluid Iron.

BY I. MCKIM CHASE.

The inquiry in your issue of the 8th of March, 1894, as to whether cast-iron expands in passing from the solid to the fluid condition, brings forward the old question of the comparative density of solid and fluid iron. This phenomenon was regarded as one of the unfathomable mysteries, until Mr. Thomas Wrightson, of England, demonstrated that iron will both sink and float in the liquid, according as its temperature is far removed or approximates that of the iron in its liquid state. He also showed that there is an expansion of the iron in passing from the solid to the liquid condition, its behavior during this transformation being similar to that of water, but in a less pronounced degree. Mr. Wrightson's apparatus consisted of a registering device driven by clock work, which caused a diagram to be traced. In application the apparatus was supported by a tripod. A rod, upon the lower end of which a sphere of cast iron was fixed, depended from the registering device by this rod moving up and down; while the clock work was in operation a diagram similar to that of an indicator was traced.

The apparatus was placed over a ladle of liquid iron of the same quality as that of the sphere on the end of the rod. The diagram revealed that when the sphere was first immersed it sunk in the liquid, but soon became expanded by heat and floated; the sphere's buoyancy increased as its expansion progressed, until the sphere attained a plastic condition, when its least density was recorded. In this condition it was on the verge of liquefaction, and could be easily pierced by a rod.

According to the foregoing, your assumption that cast-iron follows the same law that water does, and expands about the time of solidification, is correct. Its plastic condition when most expanded enables it to take the impression of the mold with fidelity and retain it when solidified.

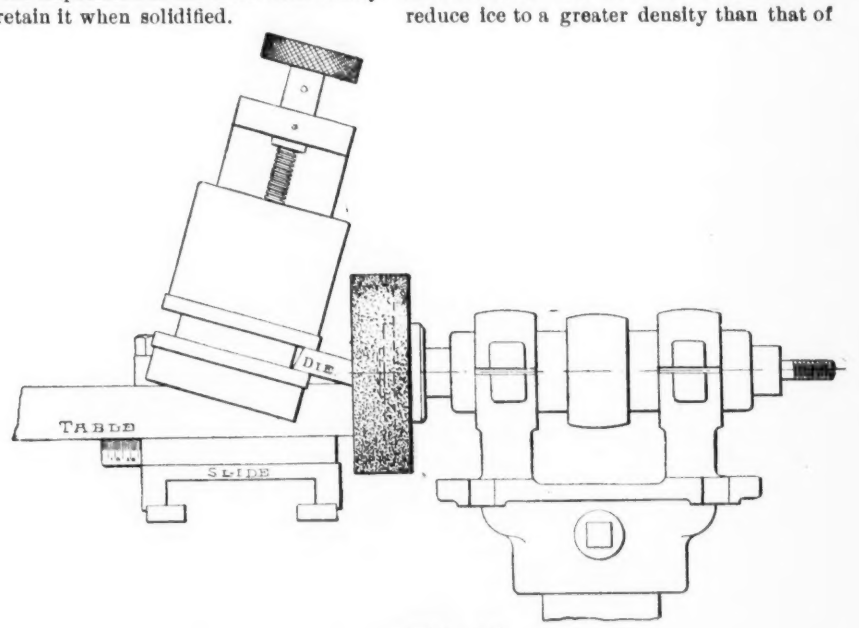


Fig. 16.

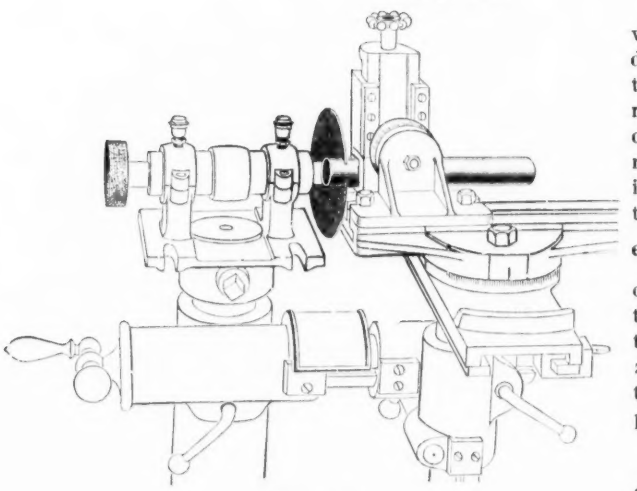


Fig. 18.

If it was not for this quality of a liquid metal expanding in passing to the solid state, there would be no sharp features in castings.

The expansion of water in freezing was formerly regarded as a remarkable exception to the supposed law that all substances contract with diminishing temperature. But there is good reason to believe that all substances which crystallize in parting with heat follow the same law that water does, that they all have a point of maximum density in the liquid state from which they expand with an elevation or diminution of temperature. Both bismuth and zinc and doubtless other metals in solidifying can be made to produce a similar effect to that of water in freezing and rupture a vessel in which they are confined.

Owing to incomplete solidification at 32 degrees ice will continue to expand for a few degrees below, but after complete solidification it will *contract* with a diminution of temperature. This fact, I believe, was discovered, if memory does not betray me, by Sir Wm. Thomson, but its co-efficient of contraction, so far as I am aware, has never been ascertained.

In comparing the density of ice and water by placing the former in the latter, there is generally but a few degrees difference in their temperatures, and it always floats. But when solid iron is placed in the liquid metal there is probably a difference of 3,000 degrees or more in their temperatures, and the contraction of the solid iron had taken place throughout this range of temperature. If ice could be reduced in temperature to somewhere near the absolute zero it is probable that its contraction would increase its density sufficient to make it greater than that of water at its maximum, which is at 39.8° Fahr., the ice would then be capable of producing the various phenomena Mr. Wrightson observed with iron in the solid, both sinking and floating in the liquid. Nor would it require an improbable amount of contraction to produce the above result, when the exceptional amount that water expands by the agency of heat is considered. Let it be assumed that to reduce ice to a greater density than that of water at its maximum density, its temperature is required to be reduced 460 degrees, or from 32 degrees to minus 428 degrees, its co-efficient of contraction would then equal $\frac{.089}{460} = .000193$, or about 6.6 times that of zinc. But the co-efficient of zinc is more than three times that of platinum.

In 1828 there were 68 French steamboats, the highest rated horse-power being 160.

Arithmetic of the Screw and of Symmetrical Rings—III.

BY LEICESTER ALLEN.

We come now to the second case in the computation of the interspace of a triangular threaded screw, that is to say, a screw wherein the bases of the convolutions do not abut, this construction being shown in Fig. 7, page 4, in the previous article. The rule (*Rule V*) for the computation in this case was also given in the last article, and the geometrical basis of the rule was therein illustrated by Fig. 9. These are again referred to for the present purpose of giving a practical example.

Example.—In a screw 10 inches long and 8 inches in diameter over all, the diameter of the barrel being 6.5 inches, base of thread, $\frac{3}{4}$ inch, as measured on a line parallel with the axis of the screw, and the pitch of the screw being 1 inch, what will be the content of a single convolution of the thread, a single convolution of the interspace, the total content of the thread, and the total content of the interspace?

Fig. 11, drawn to scale, shows that the bases of the convolutions are separated by a distance of $\frac{1}{4}$ inch.

For computing the content of a single convolution of the thread we use *Rule III*, given in my previous article, printed in issue of January 25th.

First and Second Operations.—The area of a circle whose diameter is 8 inches, we find to be 50.2656 square inches. The area of a circle having a diameter of 6.5 inches is 33.1832 square inches.

Third Operation.—Multiplying these areas together, and extracting the square root of the product, we get

$$\sqrt{50.2656 \times 33\ 1832} = 40.84.$$

Fourth Operation.—Adding the two areas and the square root of their product together, we have

$$50.2656 + 33.1832 + 40\ 84 = 124.289;$$

and multiplying this by 0.25, which is $\frac{1}{4}$ of the thickness of the base of the thread measured on the base line, we obtain 31.07225 cubic inches, which is the total content of the two frustums *a b c d* and *a b c′ d′*, Fig. 6.

Fifth Operation.—The area of a circle having a diameter of 6.5 inches we have already found to be 33.1832 square inches. Multiplying this by the thickness of the base of the thread, we have

$$33.1832 \times 0\ 75 = 24.8949.$$

Subtracting this product from the content

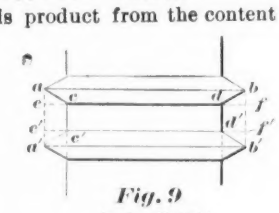


Fig. 9

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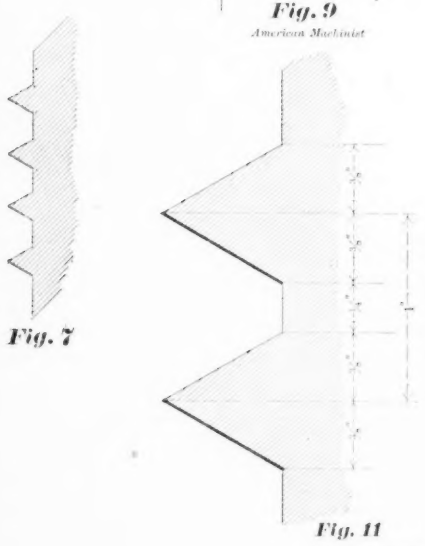


Fig. 7 *Fig. 11*

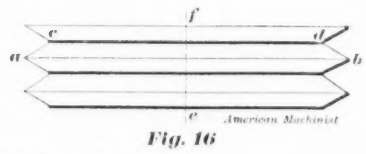


Fig. 16

Arithmetic of the Screw.

obtained in the fourth operation, we have 31.07225 — 24.8949 = 6.17735 cubic inches, which is the desired content of a single convolution of the thread.

For the interspace, we proceed as directed in *Rule V*, which in the first part also refers to *Rule IV*, both these rules having been printed in my previous article, already referred to. We first find the content of a single convolution of an interspace, the same as though the thread bases abutted.

First Operation.—The area of a circle having a diameter of 8 inches we have already found; it is 50.2656 square inches, and this multiplied by the thickness of the thread base gives

$$50\ 2656 \times 0.75 = 37.6992 \text{ cubic inches.}$$

The sum of the two areas added to the square root of their product, and multiplied by $\frac{1}{4}$ the thickness of the base of the thread, has also been found while computing the thread, as the result of the fourth operation in that computation; so we may save labor here, and take that result; it is 31.07225 cubic inches. Subtracting 31.07225 from 37.6992, we get 6.62695 cubic inches, which would be the content of the interspace if the thread bases abutted. To this must be added the content of an intermediate ring, Fig. 9, whose rectangular cross sections are *e e′ e′ c′* and *d f d′ f′*, this content being computed by the same method (*Rule I*) as though it were a ring equivalent to a rectangular thread. We have

$$(50.2656 \times 0.25) - (33.1832 \times 0.25) = (20.0324 \times 0.25 = 5.026 \text{ cubic inches});$$

and this, added to the content of the interspace obtained as though the thread bases abutted, gives us

$$5.026 + 6.62695 = 11.65295 \text{ cubic inches}$$

as the desired content of the interspace, which, for ordinary calculations, may be written as 11.653 cubic inches.

For the content of the entire thread, and of the entire interspace (the pitch being 1 inch and the length 10 inches) we have, for the thread, the following proportion:

1 : 120 :: 6.17735 : total content of thread,

which we find gives us 741.282 cubic inches.

For the interspace we have the following proportion:

1 : 120 : : 11.653 : total content of interspace.

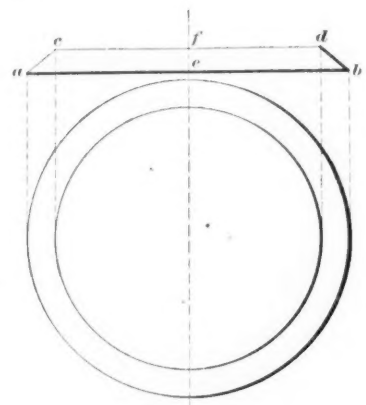


Fig. 12

Fig. 13

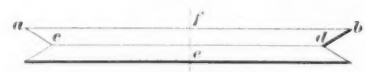


Fig. 14

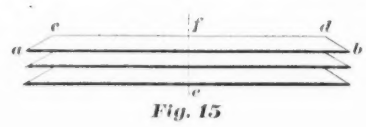


Fig. 15

From this we get the total content, 1,398.36 cubic inches.

If we now scrutinize the rules so far given, it will be seen that they involve rules for obtaining the content of a frustum of a cone, and the content of a cylinder; and by adding, subtracting, or in some way combining these, we get the volume of a ring whose content is equal to that of a screw thread having a like cross section, when the section is made in a plane that coincides with, and includes the axis of the screw. By first enunciating the rules for obtaining the content of the frustum of a cone, and for that of a ring of rectangular cross-section, we simplify *Rules III, IV* and *V*, already given, and some which are to follow.

To find the content of a frustum of a cone, Fig. 12, a double frustum like that shown in Fig. 13, or a solid made up of any number of frustums like those shown in Figs. 14, 15 and 16, the following rule applies. In these figures the diameter *a b* is usually called the greater diameter, *c d* the smaller diameter, and *e f* the height.

Rule VI.—To find the content of a frustum, or double frustum of a cone, or of a solid composed of any number of frustums of equal dimensions:

1.—Add together the area of a circle having the larger diameter, the area of a circle having the smaller diameter, and the geometrical mean of the two areas.

2.—Multiply the sum so found by one-third of the total height.

In applying the above rule, if the areas are found in square inches the height must be taken in linear inches. In general, the height must be expressed in linear units of the same name as the areas; and the content found will then be in cubic units of the same name.

The geometrical mean of any two quantities is the square root of their product.

To find the content of a circular ring of rectangular cross-section, Fig. 4 (first article of this series, issue of November 16, 1893), inspection of the figure herewith produced shows that the ring is composed of the difference between the larger cylinder *a c c′ a′*, and the lesser one *b b d′ d′*. Hence the rule is as follows:

Rule VII.—From the content of a cylinder having the given larger diameter (*a a′* in the figure) and the given height (*e f*), subtract the content of a cylinder having the given smaller diameter and the same height.

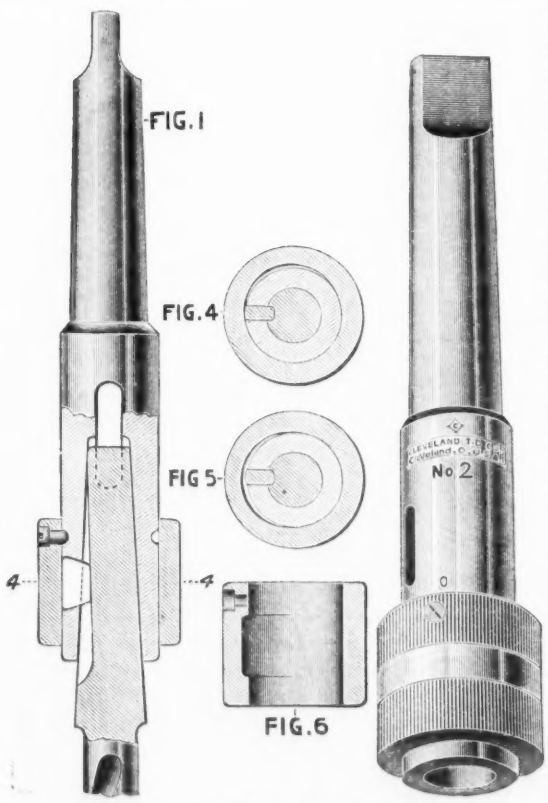
Note.—The remarks as to correspondence in the names of linear, square and cubic units, made in the paragraph under *Rule VI*, apply to this rule also, and, generally, to all operations in mensuration of surfaces and solids. The method of finding the content of a cylinder is given only for the benefit of those young readers who may wish to study these rules, but who have not yet taken a course of instruction in mensuration. If a table of areas of circles be not at hand, the area of any circle may be found by multiplying the square of its diameter by the decimal 0.7854. The area once obtained, the content of a cylinder having the given diameter is found by multiplying the area by the height.

Rule III, in the previous article, may now take the following condensed form:

To find the content of a single convolution of a triangular threaded screw, commonly called a V-threaded screw.

Rule VIII.—Find the content of a double frustum of a cone, the larger diameter of which is the diameter of the screw over all, and whose smaller diameter is the diameter of the barrel or core of the screw, and whose height is equal to the thickness of the base measured on a line parallel with the axis of the screw.

2.—From the content, so found, subtract the content of a cylinder having the same height and a diameter equal to that of the barrel or core of the screw.



A New Drill Socket.

Example.—The diameter of a screw over all is 3 inches, the diameter of the core or barrel is 2½ inches, and the base of the thread is ¼ inch; what is the content of a single convolution of the thread?

First Operation.—The area of a circle having the larger diameter (Fig. 13) is 7.0686 square inches. The area of a circle having the lesser diameter is 4.9087, and the geometrical mean (see remark under *Rule VI*) is 5.8904. Adding these numbers together, we have,

$$7.0686 + 4.9087 + 5.894 = 17.8677 \text{ square inches;}$$

and multiplying this by $\frac{1}{3}$ the total height, we have,

$$(17.8677 \times \tfrac{1}{4} \times \tfrac{1}{3}) = (17.8677 \times \tfrac{1}{12}) = 1.227175 \text{ cubic inches,}$$

which is the content of the double frustum of a cone having the given diameters and height.

Second Operation.—The area of a circle having the smaller diameter is 4.9087; and this multiplied by the height (¼ inch) gives,

$$(4.9087 \times \tfrac{1}{4}) = 1.227175 \text{ cubic inches,}$$

or the content of a cylinder having the given lesser diameter and the same height.

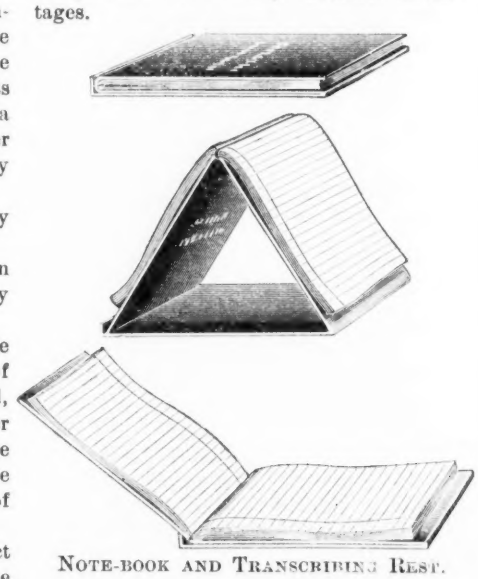
Third Operation.—Subtracting the content of the cylinder from that of the double frustum, we have,

$$1.48898 - 1.227175 = 0.261805 \text{ cubic inch,}$$

as the desired content of a single convolution of the thread.

Combined Note-book and Transcribing Rest.

We illustrate herewith a combined note-book and transcribing rest which seems to possess some very decided advantages.



Note-book and Transcribing Rest.

The cover of the book (which is of leather) is composed of three parts of equal length, jointed together at two points. At one of these joints the leaves of the book are secured by a simple rubber band in such manner as to be easily taken out and replaced.

It can be used as a note-book in the usual manner; being of convenient size for the pocket, and when notes are to be transcribed by typewriter or otherwise, it becomes a very convenient and efficient rest or copyholder, as shown where the three parts of the cover form an equilateral triangle, and the notes are held in convenient position.

For engineers or mechanics a book is provided with leaves ruled in squares ⅛ inch in faint lines and 1 inch blocks more distinct, which is thus very useful for sketches as well as notes, and when these must afterwards be put in permanent form the feature by which the book is held at a constant and convenient angle, and will keep its position upon a table in front of the worker, is a valuable one.

Cuts show cover in three positions—closed as for the pocket; open for taking notes and in self supporting transcribing position. It is made in various styles by the Greble & Wallace Co., Hamilton, Ohio.

A New Drill Socket.

Users of twist drills understand that usually the weakest point in such drills is that by which they are driven; if they have taper

shanks the flat is very apt to twist off or ruin the slot in the socket, while straight shank drills, especially the larger sizes, slip in the chuck.

We illustrate herewith a device recently brought out by the Cleveland Twist Drill Company, of Cleveland, O., which is designed to obviate this difficulty.

A steel key is let into one side of the ordinary socket and its inner side engages in a groove or flattened place prepared for it on the shank of the drill. A slight turn of the eccentrically counterbored sleeve or collar fastens or locks the key securely in its seat, and then the drill cannot be turned in the socket or pulled out. This key is so located in the body of the socket that the tang on the drill shank will fit into the usual slot or recess prepared for it, so that both are used in driving.

The advantages arising from the fact that the drill cannot be pulled out till the collar is turned back and the key released are self-evident. Heavy tools have a provoking way of dropping out of their sockets at most inopportune times, and many drills are dulled or spoiled by tapping them into place with a hammer. If this device is put directly onto the drilling machine spindle, heavy under-cutting can be done with boring bars and the labor necessary to turn over heavy castings largely avoided. These grip sockets will hold just as well and securely straight shank drills, and are furnished with $\frac{1}{2}''$, $\frac{5}{8}''$, $\frac{3}{4}''$, $\frac{7}{8}''$ and 1″ holes for straight shank drills. The company propose to put the necessary groove in the shanks of all their drills, so that they can be used in these grip sockets or not, just as the purchaser may prefer. A drill that has had the tang twisted off can be made as good as new for use in this grip socket by milling a half-round groove in the shank, or if it is not convenient to mill it, a flat place can be filed or ground on the shank, care being taken that such groove or flat place has a taper the reverse of that on the outside of the shank, as shown in the section drawing of the illustration. The small cut illustrates the reducer or shell sockets used with the "grip." The Twist Drill Company have applied the gripping device directly to several drill press spindles, and furnish collars properly constructed for that purpose. Special machinery has been put in for making these "grips," and, as all parts will be made by jigs and to standards, duplicate parts can be furnished at any time.

LETTERS FROM PRACTICAL MEN.

Device for Drill Jigs—Limit Gauges.

Editor American Machinist:

Since the appearance in your columns of my communication of the 22d ult., I have received from the Brown & Sharpe Mfg. Co. a letter, the substance of which is as follows:

"We have read your letter in the AMERICAN MACHINIST to-day, and have thought that it would be well to have it understood that the 'Device for Drill Jigs,' or, more properly, for laying out templates, was invented by Mr. Cyrus Carleton about the year 1874, and that the Limit Gauges were first used, as far as we know, about 1860, and were the result of consultation between Messrs. Joseph R. Brown and Charles H. Willcox in developing tools for making the Willcox & Gibbs sewing machines. Both the 'Device for Drill Jigs' and the Limit Gauges, you know, have been in constant use in our works since they were originated."

The above quoted letter, of course, makes the matter sufficiently plain without any further statement from me on that score, and I gladly present it that full justice may be done to all concerned.

In explanation, I may be pardoned for saying that I went to work in the Brown & Sharpe shops in 1872, and previous to the receipt of the above quoted letter had no doubt whatever that the method alluded to for jig making had been used there for some time previous to that date. I had supposed that it was already old in 1872, and had no knowledge of who it was that invented it. Of course, I never have claimed it as my method, either in my communication of the 22d ult., or elsewhere, but presented it simply as a better method than those commonly used, knowing at the same time that no secret had been made of it at the Brown & Sharpe shops, and that hundreds of mechanics who have worked there from time to time were familiar with it. In fact, I find that in the AMERICAN MACHINIST of July 17, 1890, Wendell Willis described the same method more in detail than I did, though without a sketch, and did not mention the origin of it.

As to the limit gauges, I think very few mechanics who read the AMERICAN MACHINIST will for one moment think that I intended to claim to be the originator of limit gauges, or even that my article was intended primarily or mainly to advocate their use. The time has long since gone by when that is necessary. I intended only to bring up the subject of the proper allowance, or variation from standard size for the two ends of such a gauge.

I may say, however, that I believe the limit gauge with the "not go in" end shorter than the other end is my own idea. It is of no great importance, perhaps, but the end which very seldom or never is inserted in a hole is subject to practically no wear in use, so that it does not need to be so long and the difference in length serves to make the two ends very readily distinguishable without the necessity for stopping to look at the marks upon the gauge, and that results in some economy of time. At least, I never saw a gauge so made, until very recently, by myself.

As to the proper limit of variation to be allowed for the respective ends of a limit plug gauge, there is some variance of practice on that point aside from that called for by the nature of the work to be done. My own belief at present is that the practice of making the "go in" end of such a gauge, say, .001″ below size is wrong. Such a gauge with its "not go in" end, say, .001″ large and "go in" end .001″ small allows a total variation in holes bored or gauged of about .002″, and a hole passed by such a gauge may be .001″ less or .001″ above standard.

Now suppose the limit ring or snap gauge allows the shafts to vary in the same way. The result cannot be interchangeability; for work so bored and turned may be all the way from .002″ loose (shaft .001″ small and hole .001″ large) to the other extreme of lacking .002″ of going together, which would be the case where the shaft was .001″ large and the hole .001″ small. And we should be but little better off if the shafts were made exactly to standard size, for in this case it would still be possible for the sizes of hole and shaft to overlap by .001″ and refuse to go together.

But if the "not go in" end of the plug gauge were made standard, and the "go on" ring or snap gauge were also standard, the work would always go together, the allowed variation from standard merely making the fit more or less loose, according to the limit of variation allowed.

Of course, if it is desired that the fit shall be, for instance, always at least .001″ loose, then either the "go in" end of the plug may be .001″ above standard, or the "go on" ring or snap gauge may be .001″ below standard, but for obvious reasons the latter will usually be preferable in practice.

My impression has been that limit gauges are much older than indicated in the above quoted letter, and perhaps some of your readers can give some account of their origin. If so, I should be very much interested in knowing more about it.

J. A. MCGREGOR.

Sound Castings.

Editor American Machinist:

Mr. Ramp, in AMERICAN MACHINIST, March 8th, seems to have tried treatment with his castings that, carried out by an intelligent molder and with good iron should produce good castings.

I should consider pouring them at the bottom with one or two gates at an angle to give the iron a whirl, a good if not the best possible way.

I would suggest coating the chills with red lead and oil. This is an excellent treatment for chaplets, etc. E. TROWBRIDGE.

New Haven, Conn.

Says it is an Old Device.

Editor American Machinist:

You printed an article in your esteemed paper of February 1st with the title "Some New Emery Wheels." Allow me to say to you that these wheels are not new; they have been more or less in use in Germany, France and Italy for seven years.

These wheels were first manufactured in France at Clomery. Were put in use in some of the railroad shops in France, and in some of the rolling-mills in Italy, but for general use they were not practical on account of its being necessary to constantly change the flanges; you will therefore find very few of these wheels now in use. Allow me to say that I have been a practical emery wheel manufacturer for many years in Europe, and consequently have known personally all about the experiments with this wheel in Europe. I. SCHONBURG.

New York.

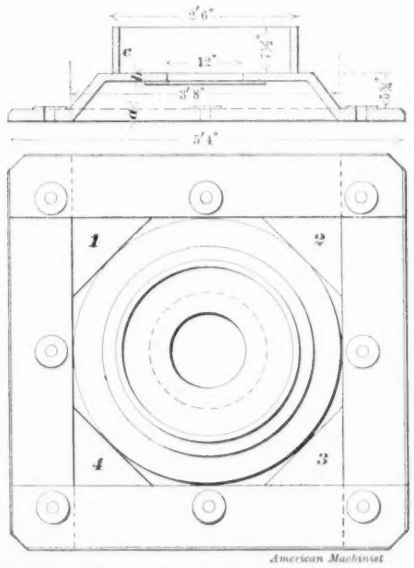
Bed Plate for Hydraulic Crane.—Hand Sketching.

Editor American Machinist:

Herewith I inclose a drawing of the above. Some years ago I was told by my employers that they intended building a hydraulic crane as per drawing that had been prepared for same, and wanted to know if I could make the pattern for the bed plate.

The only lathe I had was one of 20-inch swing, and so fixed that the "head-stock" came close to the wall. The countershaft was only long enough to carry cone to drive, when in ordinary position, so I could not bring the work to the tail-stock end. I proceeded as follows:

First, I found that the smallest step on the counter cone would drive it too fast for safety, so I turned a pulley the size required, of wood, and clamped it to the countershaft, then built a temporary bed to carry the head stock and allow the work to swing over the end of same, but I had to fix it a distance of 12 feet away from its usual place. When I had hunted up enough old belting to meet the case, my next point was to arrange something to start or stop; this I accomplished with about 35 feet of bell cord (as used on trains) and two sheave pulleys, sundry guides, etc. Then I could make it "run," but it was "wonderful if not fearful." If you look at the sectional view it will be seen that the largest diameter measures 3 feet 8 inches, so I concluded to make a board the thickness required and of octagon shape, as seen in plan view.



The frustum of cone part was built up in the usual way with part *b* on top, then the base or part *a* was fastened to face-plate, and exterior of frustum turned to size; also the top of same bored out to enable the molder to pack the sand in around the parallel ring *c*, which would be in the pit, and could not be got at any other way.

It was next reversed in the lathe, and after sawing away most of the interior of *a*, the rest of the turning necessary was done, and most of the trouble was over.

The upper ring was built up on a separate face-plate turned to size and secured in position.

After which I made a square frame halved together at the corners, and of a size to just touch four of the sides of the octagon, and to finish 5 feet 4 inches by 5 feet 4 inches outside. The corners 1, 2, 3 and 4 were next fitted and well secured with glue and nails, and after the joints were all dressed off, left an even surface. All that remained to do was to turn the different seats, which was done with the lathe in original position and consequently revolved at a much faster speed, fasten in place, bore bolt holes, and the job was ready to be shellaced, etc. The job gave satisfaction in every respect, but what has puzzled me a great many times, is that the firm could see the necessity of hydraulic cranes and many other improvements, but they have never waked up to the fact that the patternmaker did, and still does need a larger and better lathe, also more elbow room.

In your issue of March 1st, page 4, I read with interest the remarks concerning free-hand sketching, and would like to add the following. I have proved its convenience and have also been inclined "in spots" to wish I never knew how to make one:

About fourteen years ago I was in England, in the employ of a prominent builder and contractor; soon after I entered his employ I was put in charge of a job in the country, and had to send "home" for different material and hardware to match others, as it was partly a repair job. I was not very well up with the names of many things, but I could make a fair sketch, which I did, and it filled the bill every time.

On the other hand, in my present position, I am known to have sketched castings that have needed patterns to duplicate same, taken them, and made the patterns from them without further drawings. The result is that my superior must have gotten it into his head that if a man can work from a five-minute sketch (in some cases) it must be foolishness to waste time to make a proper working drawing.

I will give an illustration: In a branch shop some miles away the foreman had made an engine lathe that was giving good results, so this shop where I work decided to make one from the same patterns. I was sent there to sketch the reverse gear and different arrangements of the lathe generally. In doing so, my hands would get soiled, having to take measurements of the grease-bedaubed parts, and as a result my sketches were somewhat blurred. Now, if I had been allowed to make working drawings from them, all would have gone well, but it would take too much time. The machinist would have been able to have read it intelligently, but as it was it was rather difficult, and I was called to explain quite often.

As to a man getting paid for the accomplishment, I am not sure that in every case does he realize any monetary benefit, but there is this much, it is a pleasure in itself, and I hope that these remarks will not hinder the boys from acquiring the ability to sketch. WM. NEWTON.

Professor Sweet's Criticism.

Editor American Machinist:

The recent criticism by Professor Sweet, of Corliss engine at Philadelphia Centennial, kindly and courteous as it was, really more in the nature of a respectful suggestion from a son to a parent, came to me with something of a jar upon a spot where I was quite sensitive; rather, it brought out the fact that I was sensitive upon that subject. A relation of my experience in connection with that engine may not be without interest, as I believe it similar to many others.

The writer, then a youth of 19, fresh from an apprenticeship of three years, and one year's experience as journeyman machinist in a very small jobbing shop in a country town, arrived in Philadelphia one hot, dusty August morning, after a 48-hours' trip by boat and rail; a raw country youth on his first trip from home alone.

After due cleansing and refreshment I proceeded at once to the exhibition grounds, took the conventional ride upon the narrow gauge railway, alighted at the entrance of the main building, walked through without pause to the center of Machinery Hall and the Corliss engine. There I "took off my hat," and for nearly two hours stood and enjoyed the spectacle of what to me was the embodiment of all that was proper in an engine.

My sensations can be better imagined than described. The prevailing sense of the fitness of things formed impressions that, while I was not then able to analyze them, have colored my career since; doubtless this was the experience of others. Ambitions were aroused, a sense of the artistic side of machine design was born (it grew slowly), a determination to learn and improve mechanically was made, all in those two hours.

I also began to lose a very large bundle of conceit, which I possessed, and completely lost it during the following ten days. Since then I have had some experience in design of machinery, a disciple of "straight line" work to some extent, and if called upon to design a large vertical engine, would not curve the beams. Why? We are becoming utilitarian; the secretary would object to pattern expense of curved beams; the foreman would object to the curved valve arms; straight arms are easier to polish, or, rather make them straight with elliptical section and paint them.

I claim now that had those parts been made straight much of the beauty of motion of that engine would have been lost; as it is, the *ensemble* was a poem of graceful motion—blank verse, but a poem nevertheless that could not be produced by straight lines.

An Eastern mechanic once said to me that one feature of that engine was that the "lines of stress" fell within the "lines of resistance," an axiom which young designers will do well to paste in their hats.

I did not know during those two hours that the fly wheel was a gear, nor that there were bevel gears under the floor. A fact that speaks volumes for the workmanship that produced such an effect.

Not far from that Corliss engine there was exhibited a vertical engine making about 18 revolutions per minute, an elegant piece of work (with cabinet work attachments) made by Merrilees, Tait & Watson, Glasgow, Scotland.

Being an American youth, with accompanying cheek, I asked the old Scotch attendant what he thought of *our* engine. "Oh it is gude enough engine, but they run it too fast!"

I have heard the assertion made that the working drawings for the Corliss engine were made from figured sketches, prepared by Mr. Corliss, but cannot vouch for the accuracy of the statement.

Much more might be said regarding impressions and facts, especially some we did and did not get at the World's Fair, while we will still retain our admiration for that "land mark" of American practice, the Centennial Corliss engine. Observer.

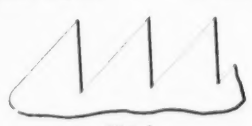


Fig. 1

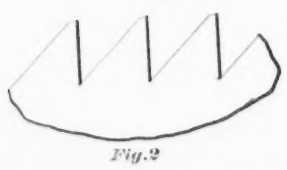


Fig. 2

Something About Machine Shop Tools.

Editor American Machinist:

Mr. "Easy Way" in your issue of January 25th tells of a single file being used 40 years. I would not undertake to tell a better story than this, but will do the best I can. Let more than one man examine a subject, and there is liable to be more than one conclusion.

The only real quick way of deciding a matter is to let one do the deciding, but when we want to get at the truth in this, as in many other things, the quickest way is not always the best.

I have heard of the famous Damascus blades that were so hard as to resist everything short of a diamond, and at the same time were so flexible as to be tied in a knot, or something like it.

I have myself made flat drills that in my opinion (*at that time*) were wonderful, wonderful because they would cut cold iron, which was a wonderful thing to me.

It is fortunate for the world that I was not entering my experience on record at that time, or else there would be a record to equal the Damascus blade, or the 40 year file.

I don't see any tools now that cut near so well, probably because I push them harder, and the stock is harder.

Sometimes a tool (like a man) is lucky enough to escape that chilled casting, that hard, sandy scale, or that hard spot on the forging, and many other places that spoil its mate which is not so fortunate. When a file is used only on work that is much softer than itself, it may last for months, but a single rub across a piece that is as hard will destroy it forever. I cannot agree with Mr. "Easy Way" that there is anything so very mysterious about the temper of a tool.

I believe it is more a question of which of two tools receives the greatest punishment.

When we rub a file against a chilled casting that is as hard as the file, and about 100 times as blunt, which of the two is going to get the worst of it?

Any good file would last a surprising long time (for a file) if it were only used on stock much softer than itself, but how are you going to do this in a machine shop?

Are you going to examine every piece of work with a magnifying glass for sand, or with a chisel for hard spots before applying your file? Would it not be cheaper to buy a new one every 10 years?

I can't help thinking that there are only two ways in the world that a file can wear 40 years. One is that it be extremely fortunate, and the other that it be in the hands of a man whose *easy ways* will not allow him to push it real hard.

I honestly believe that a good tool dresser can take steel in unannealed bars, of a quality and temper that he is used to, and make you a number of tools so near alike in quality, that it will bother you to prove which is the best. You may try one on a soft piece of stock and find it work fine, and then try another on the same piece, and find it work everything but fine, and say that the last one is not good, when the real trouble is that the last tool ran into a sand seam.

A tool may work well turning soft iron and not work very well at turning the grindstone, and I have seen wrought iron with sand enough in it to make quite a good grindstone.

When a man takes a good piece of steel, heats it carefully, and refines it well under the hammer, and then carefully tempers it, he does all that anybody can do.

If the steel has been well selected for the work, and the tool is properly shaped for work, you may expect to have a very good tool, but if you neglect any of these things you may expect to have a tool that is not so good. I fail to see any mystery in it.

You may compare the tools you are using to-day with what you used when you were young (and green, perhaps,) basing your comparison upon your memory that badly needs correcting, and you think your present tools are very bad. If they are, you would not need to look far for the mystery. In a great many cases a tool is judged too hard or too soft when it breaks or dulls without taking the work into consideration. I have known of tools being returned from a long distance away pronounced too soft, and then we used them on the hardest stock we were in the habit of using—that is, unannealed tool steel—and found them all right.

I wish to call attention to the shape of the teeth of files. Fig. 1, perhaps, shows the bad points of ordinary file teeth to rather a magnified degree of badness, but it will answer the purpose. Fig. 2 would be much better for iron or steel, but I imagine I hear some one ask how I would form such shaped teeth upon files.

With automatic machines, I see no reason why the teeth of files could not be formed cheap enough by milling or planing.

The work would not need to be done so cheaply as at present if there was a real advantage in the quality of the files turned out. Besides the advantage of better shaped teeth, there might be a large gain by having the cutting edges nearer on a straight line, so as to more equally divide the work.

It seems there is a missing link between filing and milling, and the other day I discovered it. I was looking over some old wrecks of machines at an auction sale, and I was crowded against it. It was, I think, one of the old originals, with a spindle about as stiff as my finger, with a pulley on the end about the same diameter as the cutter that was mounted upon its center. Now, imagine a cutter with teeth about as fine as a bastard file, and the end of the feed screw flatted so as to be turned with the thumb and finger, or with a monkey-wrench, when your fingers get tired, and you have a pretty good idea of this part of the machine. A few feet from this machine I saw the missing link between an engine lathe and a clothes horse. If I only owned these two machines, and the set of whiskers I saw there, I believe I could go down to New York and start quite a show.

I would not mean to show disrespect for those who, by their industry, started us toward learning, what we believe to be, better ways, but it seems as though this kind of an exhibition would be about right for those who insist upon using such ancient tools in these days. A Mechanic.

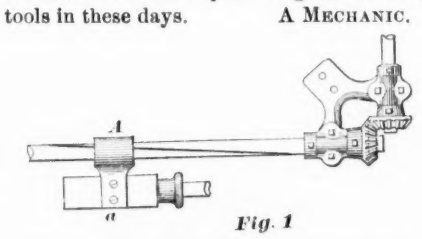


Fig. 1

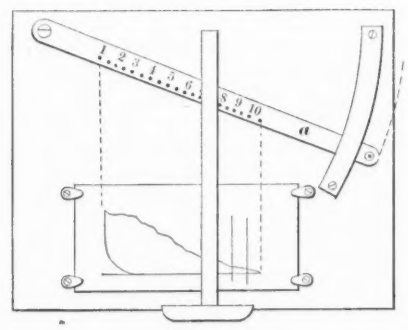


Fig. 2

Indicators and Indicator Rigs.

Editor American Machinist:

Permit me to say a few words about indicators and indicator rigs. I suppose the profession is well satisfied with the present perfected condition of the indicator. So far as the instrument itself is concerned, it seems to be all that could be desired. The trouble doubtless in making it a true index to the performance of an engine, arises chiefly from bad steam connections and actuating devices, to say nothing of the subsequent mathematical errors that creep into the measurement of its cards. As to pipe connections, there can be no question but that these should be as short as possible, and that straight-way cocks are preferable to globe valves, unless the valves be of a size larger than the pipe used, say $\frac{3}{4}$", bushed down to $\frac{1}{2}$".

In making use of an instrument of such delicate construction as an indicator must necessarily be, it is certainly proper to eliminate every element that tends to vitiate its performance. In the American Machinist of January 4th, Mr. Richards does not emphasize too strongly the importance of greater care in using indicators, when he says three fourths of the cards now taken are incorrect. Mechanically, his various reducing devices are faultless.

Makers of indicators should provide something better than reducing wheels, or lazy tongs. But why not go farther, and dispense with the "spring of the cord," by some device which will communicate a *positive* movement from the crosshead to the instrument. Whatever there may be of discrepancy in movement between the crosshead and indicator drum, and charged to badly constructed reducing levers, it is doubtful whether this amounts to nearly as much as the imperfect and unreliable action of the indicator cord.

It is hardly necessary for me to attempt a solution of this question. If the idea is worth anything, a suggestion may be sufficient. Obviously, a spirally grooved shaft, or tube, similar to that shown by Fig. 1, would serve to impart a rotary motion, similar to that of the barrel of the instrument, the actuating nut being attached to the crosshead at *a*. Bevel wheels, or toggle joints, may make the connection with the barrel. Such a mechanism possesses another decided advantage over the cord attachment, in that it would produce a card of definite length (a point well taken by Mr. Richards) a thing hardly possible, we think, on account of the stretch and yield of the cord. Perhaps a rack and pinion attached to the indicator barrel would serve a better purpose than the spiral tube as shown; this might get its motion from any of the present reducing rigs that are correct and reliable.

The importance of having cards of definite and uniform length, cannot be overestimated, especially in facilitating computations, whether made by the use of a planimeter, or graphically.

I might say here that I have little confidence in the correctness of the planimeter, for, like the indicator, its manipulation may be such as to render its work wholly unreliable.

Here, again, is a field in which to cultivate inventive talent. Let some inventor of mathematical problem working machines give us an instrument that will not only make a card, showing the action of the steam in a cylinder, but also give the mean effective pressure, and the horsepower this represents. All this capable of being read at a glance. The limit of my ability was reached in devising a small drawing board, on which to work up cards; this, however, may be old for aught I know. Fig. 2 shows the scheme, and explains itself; its object was to give an equal division for co ordinates without the use of dividers, and is adapted to any length of card from $4\frac{1}{2}$" down. The only adjustment being to increase, or lessen the angle of the graduated bar *a*, and the aligning of its extremes with the ends of the diagram. The expansion line of this card shows some of the characteristics of which we have been speaking, the result usually of springy reducing gear and cords.

Quirk.

Compound Traction Engines.

Editor American Machinist:

In your issue of March 8th, Mr. Williams falls into a natural error in speaking of traction engines. I inclose a blue print of an engine which has been in service since 1890, which would indicate that compounding is not wanting. The objection named, increased weight, is hardly correct, as for a given power, the weight is materially decreased. The real obstacle has been the dislike of manufacturers to increasing boiler pressures, which, while entirely safe, for a few years, might involve serious risk as age and disuse weaken the metal. Automatic governors have not been generally used, it seeming better to provide a variable cut-off controlled by the operator. On the road, it is customary to run without a governor, so that an automatic would have to be disconnected frequently.

This company are manufacturing these sizes of compound farm engines, viz., 5x8x8, 6x10x10, $6\frac{1}{2}$x11x10 and 7x12x12. They are to meet a demand for increased power without increased weight. They will be based upon 150 pounds boiler pressure. Russell & Co.

Massillon, Ohio.

Testing Machines—Third Monthly Meeting of Mechanical Engineers.

The third monthly meeting of mechanical engineers took place, according to announcement, Wednesday evening, at the house of the A. S. M. E., 12 West 31st street, New York. It was well attended, the auditorium seats being nearly all occupied.

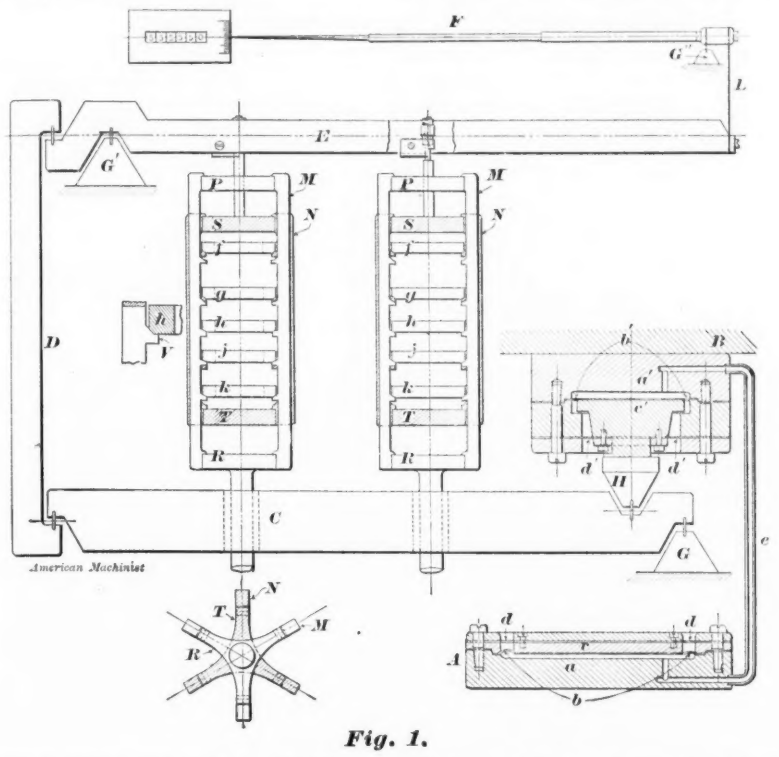


Fig. 1.

Owing to the absence of Mr. C. W. Hunt, who was expected to preside, President Eckley B. Coxe, who happened to be in the city, was induced by Mr. Forney to preside. He introduced Mr. J. Sellers Bancroft, of Philadelphia, who introduced the subject of the evening by explaining some of the recently made improvements upon the Emery machine as made by Wm. Sellers & Co., using lantern slides which we reproduce herewith.

MR. BANCROFT'S ADDRESS.

Mr. Chairman and Gentlemen:

I propose to describe to-night some of the recent improvements in the Emery testing machine, but in order that those improvements may be thoroughly understood it is perhaps necessary to go over ground which is familiar to many of you, and for that purpose I have a view showing simply the scheme of the machine.

The essential peculiarity of the Emery testing machine is the method by which the stress produced upon the piece tested is conveyed to the scale and accurately weighed by mechanism that is entirely frictionless, and that hence responds to the same increment of load regardless of the amount of strain upon the specimen.

This result is accomplished by receiving the load upon an hydraulic support or upon a group of them as the case may be; the general scheme is indicated in Fig. 1, which shows merely the relation of the parts, no attention being paid to proportion. The depth of the cylinder *a* is exceedingly small, the end is closed to prevent the escape of the contained fluid by a thin sheet of metal *b* upon which rests a piston *c* considerably smaller than the internal diameter of the cylinder; this piston is secured to the cylinder by a thin flexible fixing plate or plates *d d*, which permit a very small movement in the direction of the axis of the cylinder while rigidly securing it against any lateral movement; this longitudinal movement of the piston from no load to full load is not more than, say, .003 inch, and as there is no hydraulic packing and no sliding, there is no friction beyond that of the fluid; this hydraulic chamber is connected by a pipe *e* with a smaller but similar chamber *B*, placed in the scale, which may be at any reasonable distance; the piston *c'* of this latter chamber acts through the block *H* against the first lever *C* of the scale which thus receives a fraction of the load upon the piston *e* determined by the relation between the areas of the two hydraulic cylinders *A* and *B*.

The scale body is a rigid cast iron frame indicated by the shade lines under the lever supports *G*, *G'*, *G''*, and over the reducing chamber *B*. All the supports and connections of these levers are thin flexible plates of steel firmly secured or clamped to the levers and their supports and having a sufficient exposure between their fixed ends so proportioned to their thickness and the loads they have to carry, that the amount of bending due to the movement of the levers shall be well within the elastic limit of the material. The long arm of the lever *C* is coupled by the bar *D* with the short arm of the poise frame lever *E;* the long arm of this lever carries all the standard weights of the scale and the method of putting them on or taking them off is peculiar to the Emery system. Suspended from this lever *E* at suitable intervals by thin fulcrum plates, are poise frames *N* consisting of an upper crosshead *S* and a lower crosshead *T* united by three vertical bars disposed at equal intervals about the crossheads.

These bars are provided on their inner faces with short projecting brackets *V*, having a horizontal surface and a beveled surface which correspond with similar surfaces formed on the weights *h*, which are short cylinders or rings with beveled edges; the weights are carried by the flat surfaces and centered by the beveled surfaces. A weight frame *M* of the same construction has its three vertical bracketed bars alternating with the bars of the poise frame; this weight frame is guided and is raised and lowered in a vertical line without touching the poise frame, by a rock shaft and hand lever coupled to the rod projecting from the crosshead *R*. The brackets on the weight frame bars are differently spaced from those on the poise frame, and when the weight frame is at the top of its stroke, it carries all of the weights clear of the poise frame; a small movement downwards transfers one weight to the poise frame, the beveled surfaces on the brackets centering the weight if it becomes displaced sideways by a too sudden movement. A further movement transfers another, and so on; that is, the movement of the weight frame in either direction transfers the weights singly and successively from one frame to the other; the weights *f* and *g* are shown carried by the poise frame, *j* and *k* by the weight frame, while *h* is being transferred from one to the other.

The operating hand lever is provided with a notched segment, into which a click spring plays so that the operator feels when he has moved the lever the right distance to transfer a weight without having to watch the indicator as formerly, and the arrangement of the six bars surrounds the weights by a cage that effectually prevents any displacement and consequent interruption of the test, as sometimes occurred when the weights rested on simple shelves secured only by short-pointed pins. There is hence no necessity for opening the glass case that incloses this part of the scale, and the weights are never exposed to any risk of alteration. The weights in the first poise frame have a value of 100 pounds, the next frame carries weights of a value of ten

(*Continued on page 9.*)

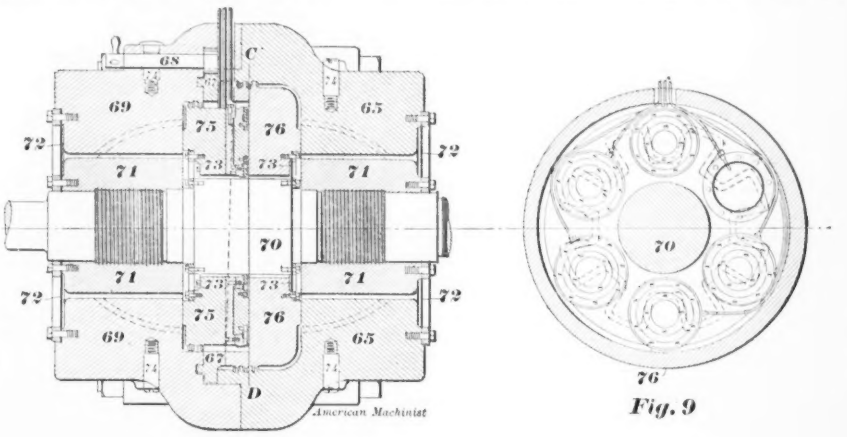


Fig. 10

Fig. 9

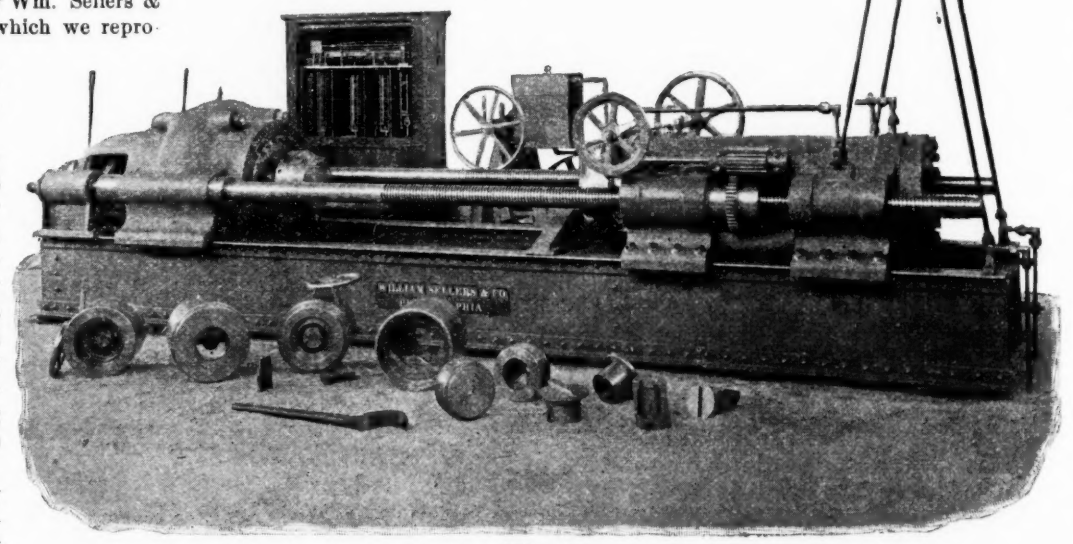


Fig. 2.

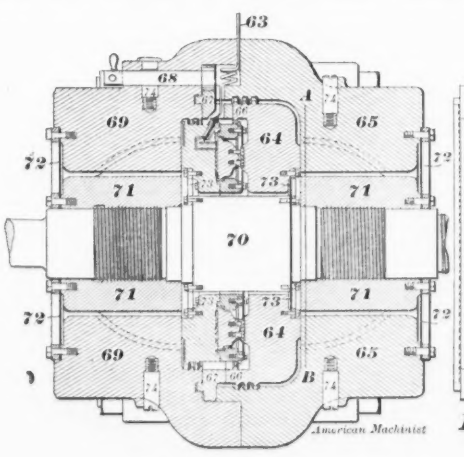


Fig. 5

Fig. 6

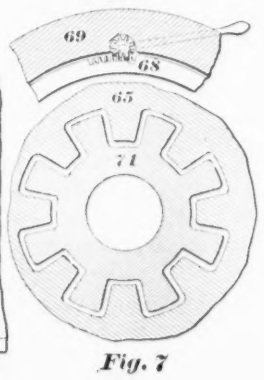
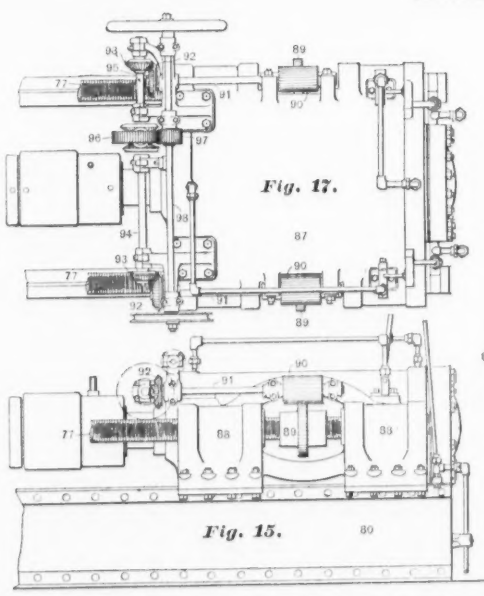


Fig. 7

Fig. 8



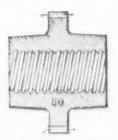


Fig. 18.

AMERICAN MACHINIST

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J. G. A. Meyer, } Associates.
Fred J. Miller, }

Special Announcements.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.*

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$3.00 a year in advance, postage prepaid, in the United States, Canada, and Mexico.
$4.00 a year to Other Countries, postage prepaid.

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Bream's Bldg's, Chancery Lane, London, E. C., Eng., or Stefanstrasse 18, Leipzig, Germany, will receive subscriptions for the American Machinist, at 16.6 per annum, English currency, or 17 marks per annum, German currency, postpaid.
Subscriptions received in Paris, France, by E. Terquem, 31 Boulevard Hausmann, at 21 francs per annum, postpaid.

Subscriptions received in Australia by W. Williams, 17 and 21 Fink's Buildings, Melbourne.

NEW YORK, MARCH 22, 1894.

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Third Meeting of Mechanical Engineers.

The meeting of mechanical engineers, held at the house of the A. S. M. E., the evening of the 14th inst., was very well attended, the auditorium being well filled. Mr. J. Sellers Bancroft's introduction of the subject of testing machines was listened to with marked attention and interest; while Mr. Gus. C. Henning's account of historical and noteworthy testing machines of American and foreign construction, illustrated by lantern slides, was also very interesting.

The conduct of the meeting showed, however, how very difficult it sometimes is to carry out original plans for such meetings. The original plan of the meetings, if it had been adhered to, would have resulted in a discussion of the features of the Emery machine as presented by Mr. Bancroft, and a general discussion of the broad subject of testing machines and tests, in which all who desired or could have been induced to speak, might have taken part. There is no doubt whatever that this plan is a good one, and, in our opinion, it should be rigidly adhered to. In that way only can the interest be kept up which is necessary to sustain such meetings.

Men are most interested in proceedings in which they can take more than a passive interest, while those who are invited to introduce the subject of discussion, are entitled to hear as full and general discussion of it as is possible to be brought out.

The illustration and description of historical and other machines, all will agree, was of very great interest, and we shall hope the matter composing it will be presented to the A. S. M. E. as a formal paper, but it was unfortunately introduced at such a time as to effectually prevent the general discussion, which we believe is necessary to the complete success of the meetings.

Out of the Beaten Path.

We have sometimes referred to the fact that it was very commonly those who knew very little about a machine or a process that undertook improvements and besieged the Patent Office with their conceptions in the way of applications for patents, which, through the rather loose methods prevailing, were quite generally granted. Hence the great number of patented improvements that do anything but improve, and that in some little corner of the claim or specification, or in some lines of an irrelevant drawing, stand right in the way of real improvement by another. While apologizing for nothing that has been said in the direction of this line of thought, upon which we believe it will be agreed that too much emphasis is not likely to be placed, especially by genuine inventors who have, perhaps, time and again, been balked in their endeavors to secure government protection for something in every way valuable by the interference of some point of no earthly value, except in the way they proposed to use it, but in the doing of which they were prevented by the fact that some one had proposed to use it in a way that every man could see that it would accomplish no useful purpose; while apologizing for nothing of this, it would be hardly fair to rest the matter without an admission that, while the efforts of those above referred to are generally rank failures—not only failures in themselves, but standing in the way of progress—the reverse of this is sometimes strikingly true. This is more likely to be the case in the instance of some process of manufacture than in the construction of a machine, although it must be admitted that it occurs in each instance. Sometimes the very lack of specific knowledge, strange as it may seem, has, apparently, been advantageous. This seems to be because, unhampered by custom and traditions, the inventor has traveled fields that he would not otherwise have thought of exploring, and in so doing has arrived at results not in the book, so to speak. There is no reason to doubt that men get so tied down by this same custom and tradition as never to look for a way to an end outside the well-worn—worn out—path, and the new way is discovered by some one who would never have looked for it had he been more familiar with the old path. But this is the exception, not the rule. It stands out, for all this, as plainly as anything can stand out, that the physician, not the carpenter or the machinist, should prescribe for the physical ailments of the sick man. What appears to be the boldness, not to say rashness, of an attempt is frequently something born of ignorance rather than of either of the qualities named, and such attempts, when successful, demonstrate the fact that there are roads to almost every end that years of familiarity have failed to reveal—have actually hidden—and that will never be known except they be stumbled upon.

There is no class of men in a city more directly interested in the honest conducting of municipal affairs than manufacturers. It would appear at first thought that a moderate contribution in the way of increased taxes to cover municipal dishonesty was not such a serious matter; it is serious, but if this were all, or the worst of it, it might be tolerated. But it is not all nor the worst of it. The manufacturer employs a thousand men, perhaps. Every one of these men is affected by the manner in which the affairs of the city are managed, and this all reacts upon the manufacturer. They must all pay more rent, or more for board, and more for everything they buy than if city affairs were economically and honestly managed, and the result is the manufacturer must pay more in wages or put up with inferior workmen, which is still worse. A workman will not work for the same wages in a city where it costs him twenty five per cent. more to live, than it does in another city, other things being equal.

Every locality has come to understand the advantages of manufacture employing men who in turn support other manufacture and tradesmen, and so make business lively and money plenty, or, at least, distribute it. But every locality does not understand the influence of a notoriety for dishonest management of public affairs in keeping away and driving away manufacture. Some time this matter will be better understood, but at present but little attention is given to it in this country. It plays a most important part in the location of manufacture, and in the kind of workmen that will be found in a city or town.

There is no doubt that the growing use of electricity will, in the end, materially help the trade in water wheels that has been rather hardly pushed by the steam engine. Water powers are being, and will be, turned to account that would remain dormant but for electric distribution of power. Where mills and factories cannot be well located the energy of the falling water may be taken by electricity to convenient positions, and to some extent this is being and will be done. This will, however, cut but a small figure in the manufacture and sale of steam engines—probably not enough of a figure ever to be noticeable. It will in some instances provide for locating shops and factories that would not otherwise be built, and provide for the lighting of places that would otherwise grovel in the darkness of gas, or oil lamps. Electricity will help the water wheel without, to any appreciable extent, injuring the steam engine.

Samuel Van Sickles, who, it is said, built the first pipe line for oil, recently died at Buffalo, N. Y., at the age of 83. He was famous during the oil craze from having at one time bought up all the oil barrels in the market, and all that the cooper shops could produce for six months. This gave him a monopoly in the oil-shipping business, out of which he made a fortune. Finally, on account of the high prices charged by teamsters, he laid a pipe line, the plan being ridiculed by every one. It worked, however, then the teamsters tore it up, compelling him to post armed guards for its protection. Eventually he lost his fortune in the oil business, where he had made it.

A bill now before the legislature, the intention of which is to prevent the use of any part of the elevated railroad structures for news stands and huckster shops will, we should think, meet with almost universal favor. The *New York Tribune* very properly points out that these stations are tolerated only because they are a necessity, and should be used for no other purpose than that for which they were ostensibly built. To allow them to be used for trade purposes is an injustice to shopkeepers who pay rent for the places in which they do business, and gives to the railroad company a privilege to which it is in no way entitled.

Literary Notes.

A POCKET-BOOK OF MARINE ENGINEERING RULES AND TABLES. For the use of marine engineers, naval architects, designers, draftsmen, superintendents, and all engaged in the design and construction of marine machinery, naval and mercantile. By A. E. Seaton, M. Inst. C. E., M. Inst. Mech. E., M. of Council, Inst. N. A., and H. M. Rounthwaite, M. Inst. Mech. E., M. Inst. N. A. With diagrams.

This book deals with marine engineering matters only, and although the introduction of extraneous matter of only general interest has been avoided, marine engineers and others having to do with ships and their machinery will find that nothing of use and importance has been omitted. This careful selection of matter keeps the bulk of the volume within very handy limits, without any crowding of matter. Comparatively large type is used for the reading pages and tables, a fact which we know will be appreciated by draftsmen whose eyes are often put to a severe test in working over a drawing board from morning until night, and who consequently do not care to subject their eyes to an additional strain of reading fine print so often used in pocket-books. We also notice another notable feature which commends itself, tables, such as areas and circumferences of circles, square, cube roots, etc., to which reference will have to be made very frequently in every-day practice, are placed at the end of the book, so that they can be readily found. The book is not only admirably adapted to the use of engineers, designers, draftsmen and superintendents but its character is such as to make it extremely useful and valuable to practical men. We can recommend it without hesitation, as one of the best pocket-books of its kind in the market, and we have no doubt but that it will receive the highest commendation from all who have occasion to use it. The book is published by D. Van Nostrand Company, 23 Murray street, and 27 Warren street, New York. Price $3.

Locomotive Engineering (912 Temple Court, N. Y.) has published and issued with its March number an elegantly engraved reproduction of a drawing of the now famous locomotive 999, which was exhibited at Chicago. It is shown as though some of the parts were transparent, and thus all the parts are shown in their true proportions and positions, and these are numbered and listed in a marginal reference, which gives their correct names.

This engraving has now been printed on extra plate paper for framing and is mailed for 50 cents.

We have received a copy of a pamphlet containing a translation of that part of the report of Monsieur E. Kugler, Machinist, which pertains to the factory of the American Watch Tool Company, at Waltham. Mr. Kugler was one of the special commissioners from the city of Paris, sent over here last year to investigate industrial matters, and the American Watch Tool Company ought to feel highly gratified with the very complimentary terms of the report, which goes somewhat into detail as to what is to be seen there, and the means employed for doing a very high grade of work.

The bound volume of *The Locomotive* comes to us as usual. Following as it does

the regular monthly editions of this publication, of which the volume is composed, it seems to add something by putting the information given in installments in a form to be come at at once and together. The little volume, full of useful information, can be had of the Hartford Steam Boiler Inspection and Insurance Co., Hartford, Conn , for one dollar.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(138) L. W. S., Carthage, N. Y., writes: Please inform me where triple-expansion engines from 6 to 8 horse-power are made, or where I could obtain castings for this size of engines. *A.*—Write to any builder of steam engines; the addresses of some of these are given in our advertising columns.

(139) L. W. S., Macon, Ga., writes: I have a small plain upright engine, to which I desired to attach a link motion. The travel of the valve is ¾ inch, distance from center of shaft to center of link pin $18\frac{1}{16}$ inches. What should be the distance between the eccentric rod pins in the link? *A.*—2½ inches.

(140) E. F. B., Buffalo, N. Y., writes: I wish to buy the latest thing in the shape of a slide rule. What kind would you recommend for general shop and drawing room use? And who keeps it for sale? *A.*—Keuffel & Esser Co., Fulton street, New York, keep the slide rules which are generally used by engineers and practical men, and highly commended by those who have occasion to use them.

(141) Andy, Bartow, Fla., writes: I have under my charge a steam digger used in digging phosphate. The wire rope is ¾ inch in diameter, running through a 12-inch sheave. I find furrows in the bottom of the sheave; they were formed in less than four days; will they hurt the rope? *A.*—The furrows will hurt the rope, but the rope will be subjected to a greater injury by the use of the small diameter of sheave, which should not be less than 24 inches diameter for the given size of rope, in fact, a still greater diameter will be better.

(142) P. M., Pittsburgh, Pa., writes: We would like very much to have your ideas on aluminum patterns as compared with iron ones. We have a number of iron patterns in daily use in our foundry, and find them rather heavy for men to handle. We would like to know what grade of aluminum to use, the cost, and how to cast and finish it. *A.*—We do not believe aluminum is used, at least not to any extent, for patterns, nor that it has much value for the purpose. However, some of our readers may be better informed, and if so we should be pleased to hear from them.

(143) R. C., Brooklyn, N. Y., asks: Can I use the branch tees, which are used in radiators, in a pipe boiler for a small launch, say 3 horse-power? They are made of cast-iron. I have made such a boiler and found the tees to stand more than 300 pounds, and have used a pressure of 100 pounds. I have been told that such a boiler would be rejected by U. S. boiler inspectors on account of the tees being made of cast-iron. *A.*—Such castings are dangerous to use for steam boilers; some of these castings may stand considerable pressure for a short time, but they are liable to give trouble, and may end in disastrous results. These fittings should be cast of malleable steel, which will be passed by the inspectors of steam vessels.

(144) S. R., Hartford, Conn., asks: How are blue prints made? Please give full particulars. *A.*—See answer to Question 120, in our issue of March 8th, current volume. 2. Which side of the tracing cloth, the smooth or rough side, should be turned up? *A.*—Some draftsmen draw on the smooth side, others on the rough; in making blue prints always put the face of the tracing, on which the lines have been traced, on the glass. If you do make a mistake, and lay the wrong side of the tracing on the glass, it is not likely you will make the same mistake the second time. 3. Can any other ink besides Indian ink be used for this purpose? *A.*—You can use any other black ink for making the tracing, but Indian ink is the best to use, and will not injure the drawing pens as other common inks will do. 4. How many prints can be taken from the same copy? *A.*—As many as you please, one at a time.

(145) F. H. S., Wayne, Ill., writes: Please give me the names of one or two books treating on steam engines (Corliss, etc.), pumps and electric plants. I will give you an idea of what I want. In the first place, I have a good education in mathematics and sciences, and have a fair knowledge of the operation of steam plants, understanding the setting up and running of common slide-valve engines. But I desire to make a special study of this branch of engineering. *A.*—"The Steam Engine," by D. K. Clark, treats on the different types of engines and boilers, the combustion of fuel, economical generation of steam, etc. "Practical Treatise on the Steam Engine," by A. Rigg, treats on steam engines, but not on boilers. "Manual of Marine Engineering," by A. E. Seaton, is another good work. "Treatise on Steam Boilers," by R. Wilson. "Pumping Machinery," by W. M. Barr. "Corliss Steam Engine and Allied Steam Motors," by W. H. Uhland, and "Continuous current Dynamos and Motors," by F. P. Cox.

(146) T. C. R., Dayton, O., writes: Please give me a rule for computing the weight of fly-wheels for engines, particularly gas engines. *A.*—For steam engine fly-wheels the following formula gives good results:

$$\frac{12{,}000\,000}{D^3 \times R^2} \times A \times S = W,$$

in which D = diameter of the fly-wheel in feet, R = revolutions per minute, A = piston area in square inches, S = stroke in feet, and W = weight of fly-wheel rim in pounds. The weight of fly-wheel for gas engines depends on the type of engine, and it is difficult to give a rule that will give satisfactory results in all cases. For engines in which the charge is fired with every revolution we should use the rule as given above, but with this difference, in place of the constant 12,000,000 use 24,000,000. 2. Please explain the meaning of indicated and actual horse-power of gas engines, frequently given in catalogues. *A.*—The indicated horse-power is calculated from the mean effective pressure in the cylinder determined by an indicator. The actual or net horse power is calculated from the pressure exerted by the engine in doing useful work, which can be determined by a dynamometer; in short, the net horse-power is the indicated horse power minus the power required to overcome the friction of the engine. 3. Can I receive copies of any patent by forwarding to the commissioner 25 cents in stamps? *A.*—Stamps are not accepted by the commissioner. The price of uncertified printed copies of patents is now fixed at the uniform price of 10 cents each, whether purchased singly or in quantities. In ordering a copy of any patent give name of patentee, invention, number and date of patent.

(147) W. W., Montreal, Can., writes: Please give me a rule for computing the thickness of cast iron cylinder heads. For instance, what should be the thickness of the cast iron heads bolted to flanges of a heater 30 inches diameter carrying a pressure of 100 pounds per square inch? The heads are not to have any stays. Also give formula for wrought iron heads. *A.*—The thickness of circular heads firmly fixed at the circumferences is found by the following formula:

$$t = \sqrt{\frac{2 \times r^2 \times p}{3 \times f}},$$

in which t = thickness in inches, r = radius of head in inches, p = pressure in pounds per square inch, and f = allowable working stress which depends on the ultimate tensile strength of the material. If we assume that the ultimate tensile strength of cast iron is 20,000 pounds, and allowing a factor of safety of 8, then the value of f will be $\frac{20{,}000}{8} = 2{,}500$. To apply this formula simply substitute for the symbols the values given in the question, and then find the thickness as indicated by the signs, thus:

$$t = \sqrt{\frac{2 \times 15^2 \times 100}{3 \times 2{,}500}} = 2.45 \text{ inches.}$$

The same formula is also used for wrought-iron. In applying it the proper value of f must be found. If we assume the ultimate tensile strength of wrought-iron is 44,000 pounds, and allowing a factor of safety of 8, then the value of f will be $\frac{44{,}000}{8} = 5{,}500$, and the thickness of the wrought-iron will be

$$t = \sqrt{\frac{2 \times 15^2 \times 100}{3 \times 5{,}500}} = 1.6 \text{ inches.}$$

(148) L. A. N., La Jara, Col., writes: I would like to inquire if any back numbers of your journal contain a description of an apparatus for brazing that could be economically constructed by an amateur. I have in my mind one for using gasoline, the blast is to be supplied by a small foot bellows, the construction of which I would like to have specified. Our local tinsmith could construct a suitable tin vessel for holding the gasoline, a small gas pipe could be run to connect with the burner where the flame and blast could be properly combined for hot brazing frames. Is this a practical idea? *A.*—The idea is practical. In place of the bellows you may use another device for maintaining a continuous supply of air for blow-pipe use. It consists simply of a small cast-iron cylinder with an open and a closed end; this cylinder is attached, with the open end downwards, to a vertical bracket which carries at the bottom a treadle to work a plunger in the cylinder. A hole through the closed end of the cylinder with a small hinged valve on top will admit air into an air chamber fastened to the top of cylinder. A few rapid strokes of the plunger will raise the pressure in the air vessel to 10 or 12 pounds, and this can be easily sustained with but little exertion. Under this pressure, which is suitable for brazing, annealing, fusing, etc., the air is driven through the minute opening in the blow-pipe nipple with great force, creating, it is claimed, more heat than when a larger jet of air is used under a low pressure, as with the bellows. For light and delicate work, when a gentle flame is required, a pressure of one or two pounds in the air chamber is sufficient. The blow pipe may be used effectively with a gas, gasoline, alcohol or oil flame. Of course the treadle for a bellows, if it is desirable to use one, can be rigged in a manner as described above. We have described other constructions of blow pipes in a former issue, but this is now out of print; if you or any of your friends have back volumes you will find these descriptions in our issue of February 20, 1886.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

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"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 post paid. Published by John Wiley & Sons, 53 East Tenth street, New York.

Testing Machines—Third Monthly Meeting of Mechanical Engineers.

(*Continued from page 7.*)

times as much, or 1,000 pounds, the next 10,000 pounds, and so on, and the readings are summed up by a series of segments connected to the several operating shafts and provided with figures denoting the number of weights on each poise frame. A horizontal slot in a vertical plate near the upper left-hand corner of the scale is so placed that the reading of the figures shown through this slot denotes the number of pounds pressure applied to the specimen.

The final lever of the scale is an indicator needle F, which has a movement at its point of $1\frac{3}{4}''$ to $2''$, and this movement, calculated from the mechanical ratios of the hydraulic chambers and of the levers in the scale, is not less than 300,000 times the movement of the piston c in the first hydraulic chamber, and may on large machines be 6,000,000 times as much. The transfer of fluid from one chamber to the other is almost imperceptible, and while it takes force to move the metal sheets and to bend the steel fulcrums, yet this force is all returned as the various parts resume their position of equilibrium, the needle returning to the same zero point after being disturbed in either direction.

The Emery testing machines are now made horizontal instead of vertical; in the first place to make all sizes of machines of one type, and in the second place to get certain advantages in overcoming the shocks of recoil. In all but the very smallest size of machines, the weighing head and the hydraulic cylinder or straining head are carried and aligned by the top surface of a wrought-iron bed, as shown in this view of a 200,000-pound testing machine (Fig. 2) the straining head on the right-hand and the weighing head on the left, back of which stands the scale, and to its right is the pump; in the foreground are the parts of the tension holders.

The weighing head (Fig. 5) consists of two circular or annular beams, 65 and 69, firmly secured together by bolts placed around their periphery and by the straining screws which pass through both beams and clamp them by a shoulder and nut. This head and the straining head fit easily upon the bed which maintains the axes of the two heads in the same straight line. A draw bar, 70, is secured in the axis of these beams by two thin annular steel plates, 72, bolted against shoulders near the ends of the draw bar and secured firmly in recesses formed in the outside face of each beam. These plates hold the draw bar securely in line with the axis of the machine, while permitting a free motion to a limited extent in the direction of the axis. The projecting end of the draw bar is provided with a screw thread by which the compression platform or the tension holder is secured to it. The draw bar is enlarged in the middle, and against each of the two shoulders thus formed, is secured a thin annular steel plate, 73; these plates are for the purpose of carrying and centering the hydraulic support, which is made annular, instead of circular, as shown in Fig. 1, and is placed centrally about the axis of the draw bar, so that end stress on the draw bar is resisted symmetrically by the hydraulic support, the part corresponding to the cylinder being secured to one plate and an abutment ring secured to the piston being secured to the other plate, while the cylinder and piston are also separately coupled by flexible plates. By this means the hydraulic support is maintained in fixed relation with the draw bar laterally, while it is left free to move relatively to it in the direction of its axis through the small distance required. On each side of the hydraulic support, steel collars, 71, are screwed and secured to the draw bar; these collars are provided on the periphery, with a series of ribs (Fig. 7) parallel with the axis of the draw bar, and which lie between without touching, similar ribs projecting from the interior surface of the annular beams. The ends of all these ribs on the two beams and the collars are accurately faced to true planes at right angles to the axis of the draw bar, and the distance between the two extreme faces of the hydraulic support is made slightly less than the distance between those two planes. Movement of the draw bar in either direction carries the hydraulic support against the ends of the ribs in one annular beam, brings the ends of the ribs on one of the collars on the bar against the opposite side

of the hydraulic support, and produces pressure on the contained liquid which is transmitted through the pipe, 63, to the small hydraulic chamber in the scale. For the purpose of insuring that everything about the hydraulic chamber has a solid bearing, it is necessary to produce an initial loading of about 5 per cent. of the maximum load, which is done by applying a definite spring pressure to move the draw bar in the direction in which the stress to be applied to the specimen will move it, and after this the scale is balanced in the usual way by sliding weights on the poise beam.

In order to prevent the shock of recoil, resulting from the rupture of a large specimen of high steel, from doing injury to the thin brass plates in the hydraulic support, the abutting piece, 64, of the support which rests against the ribs in the annular beam, 65, when strains of tension are applied, is made larger in diameter than the hydraulic support proper, and is provided with a spiral or screw face, 66, which engages with a corresponding screw face formed on a rotatable ring, 67, fitting in the other annular beam, 69. After the initial load has been applied, this ring is rotated by the pinion shaft 68, to bring the screw faces in contact, see Fig. 6, and the abutting piece, 64, is thus clamped firmly to the annular beam against which it rests. When the specimen breaks, its first blow is delivered through the draw bar and ribbed collar to this abutting piece, 64, which transmits it through the ring, 67, to the rear annular beam, 69, and as these beams 65, and 69, are rigidly united, the blow is absorbed by the total mass of these two beams. The hydraulic support is thus thoroughly protected, and these machines can be used regularly for breaking high steel specimens up to the full capacity of the machine without any risk of injury.

The weighing head is returned to its place on the bed after movement due to recoil by a set of spiral springs locked up in boxes secured to the bed, shown at the extreme left-hand end of Fig. 2; these springs are strong enough to move the head and their resistance diminishes greatly the movement due to recoil while the friction of the head upon the bed rapidly wipes out the oscillations.

The annular beams bolted together, as described, constitute one built up beam to resist the bending due to the pressure on the draw bar midway between the straining screws. The hydraulic support is thus inclosed in a rigid mass of cast iron and effectually protected against injury from violence or from being gummed up by oil from the straining cylinder, as has occurred with the upright machines, and the frictionless movement of this support under all conditions of service is thus insured.

Figs. 9 and 10 show a method of making the hydraulic support for very large machines, or when the annular support just described would become too large to be rated by the support testing machine. In this case the supports are made circular and are grouped symmetrically about the axis of the draw bar; as shown in Fig. 9, they may be all coupled together by one pipe or connected as shown by individual pipes to one or more reducing chambers in the scale. The cylinders of the supports are secured to the ring, 75, and the pistons to the ring, 76, which is provided with a screw thread on its overhanging rim, and is clamped by the ring, 67, as before described.

Two straining screws, 77, are provided (Figs. 15, 16 and 17), fixed firmly to the weighing head and passing freely through bearings, 88, formed on each end of the straining head, 87; a revolving nut, 89, provided with gear teeth on its periphery, is placed on each straining screw between the two bearings, 88, formed on the sides of the straining head; these nuts are revolved by the wide face pinions, 90, driven through the bevel wheels, 92 and 93, by a balancing train of gearing consisting of a gear wheel, 96, carrying two balancing bevel pinions, (see Fig. 17) meshing with two bevel wheels, one on each side of the first gear wheel, 96, so that power applied to the gear, 96, is by means of the balancing pinions divided equally between the two bevel wheels, and thus imparts equal pressure to the revolving nuts, 89, on the straining screws. This arrangement does away with the necessity heretofore existing of having the straining screws of exactly similar pitch throughout their length. With this construction the screws could be of different pitches, the alignment of the heads being secured by the fit of the screws in their bearings and of the heads on the wrought-iron bed or shear; by driving this train of gearing either by hand or by power, the straining head is moved back and forth upon the bed to accommodate the varying lengths of specimens; when the head is adjusted to place, the nuts form the abutments upon the screws to resist the movement of the cylinder for strains of compression or extension. The nuts, 89, do not fit snugly endwise as heretofore, but a space of several inches is left between the ends of the nuts, 89, and the faces of the bearings, 88 (see Fig. 15). This provides for the shock of recoil when breaking a long and large specimen, the sudden release of the straining screws from their load when the specimen breaks, together with the force resulting from the sudden contraction of that end of the specimen attached to the straining head, merely give the head a push along the bed and it slides freely until its momentum is absorbed by its own friction, the space between the re-

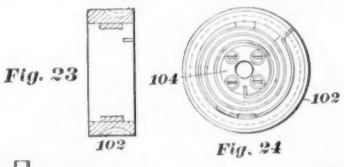

Fig. 23. Fig. 24.

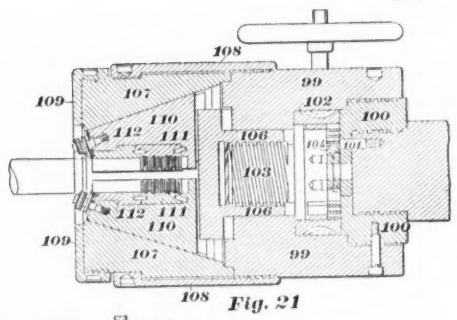

Fig. 21.

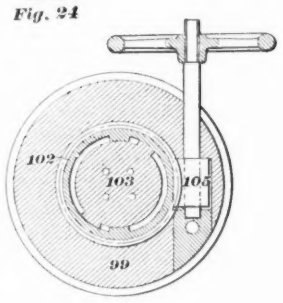

Fig. 22.

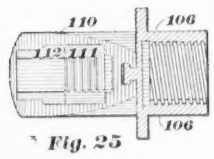

Fig. 25.

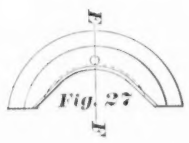
Fig. 27.

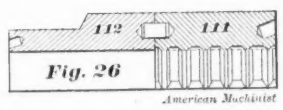

Fig. 26.

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Fig. 29. Fig. 32.

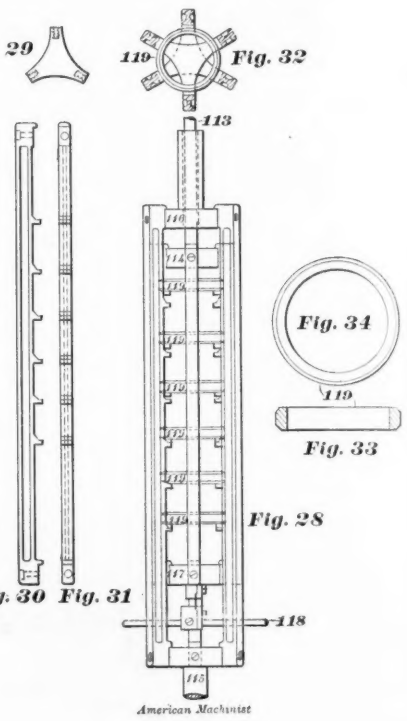

Fig. 30. Fig. 31.

Fig. 34.

Fig. 33.

Fig. 28.

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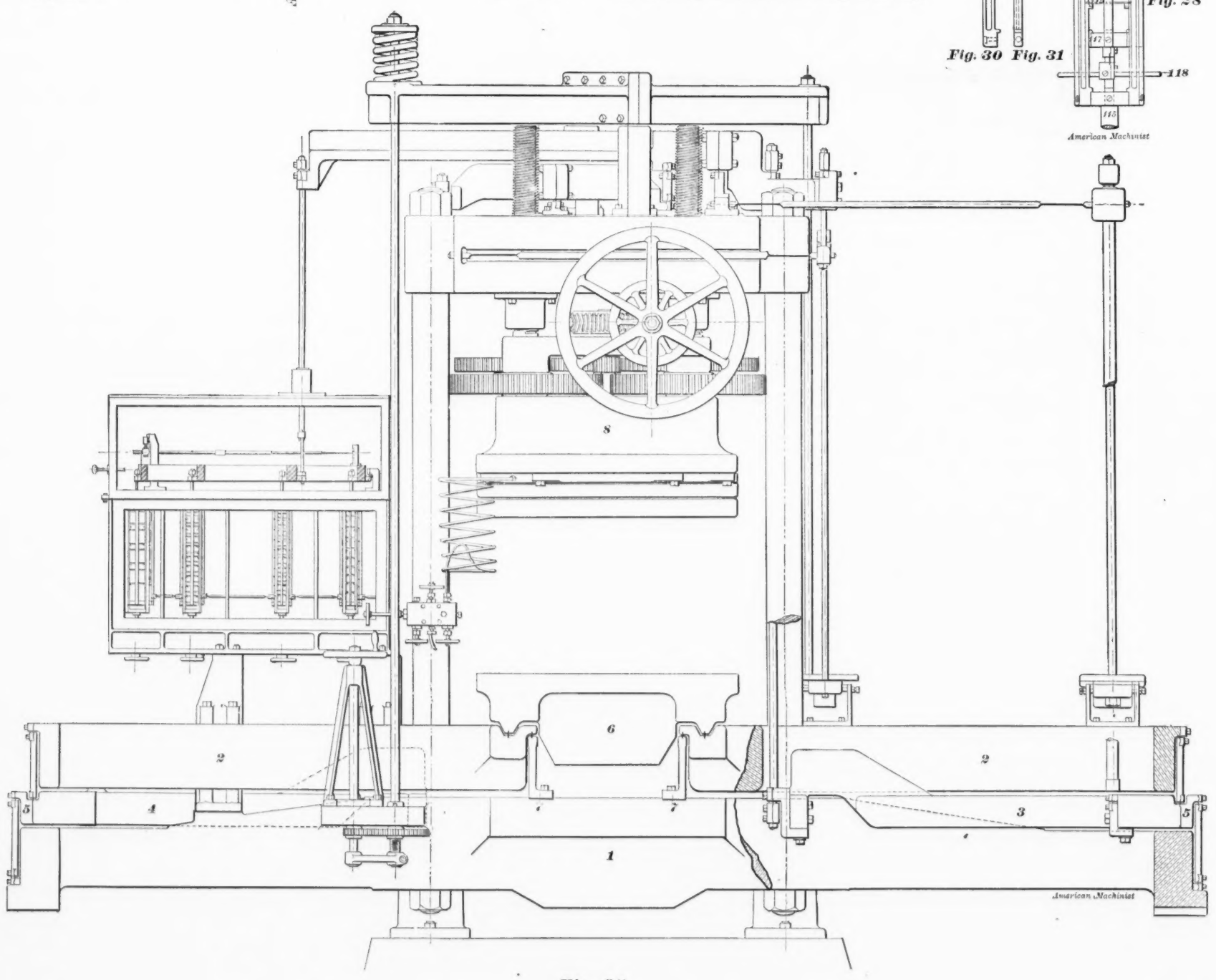

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Fig. 35.

volving nuts and the bearings allowing ample room for this travel even when the heads are thoroughly lubricated. This head is thus entirely cut off from the rapid vibrations of the straining screws, and the necessity of making the nuts an exceedingly good fit to both screw and head is entirely avoided.

The straining head is provided with a piston packed to receive fluid pressure in either direction, and the piston rod passing through a packed bearing in one end, is provided with a screw thread, similar to that on the draw bar, to receive the various holders. The fluid is supplied to this straining cylinder through two systems of jointed pipes, which are connected through the valves at the scale case with the pressure pump and the tank respectively, so that each pipe acts either as a pressure pipe or an exhaust pipe, depending upon the direction in which the strain is to be exerted upon the specimen.

The tension holder for gripping specimens for extension tests is shown in section in Fig. 21. A steel case consisting of the two parts, 99 and 107, united by the nut, 108, is secured to the end of the draw bar or piston rod by the screw thread described. The gripping jaws, 110, are two cylinders that slide freely in cylindrical holes bored in the case, 99, at an angle of about 20 degrees with the axis of the case making an angle of, say, 40 degrees with each other, the axes of the jaws and of the case being in the same plane. The rear end of each of these jaws is provided with a "T" slot lying in this plane, and at right angles to the axis of the case which engages with a "T" rib formed on a crosshead, 106, that fits in a bearing in the case, and compels the jaws to move equally and simultaneously, see Fig. 25. The crosshead is provided with a screw thread in its interior to receive an abutment screw, 103, which forces the jaws forward and closes them upon the specimen. This screw is operated by an annular worm gear, 102, provided in its interior with two narrow lugs, Figs. 22 and 23, which engage with two similar lugs formed on the abutment screw, so that the worm wheel could make almost a half revolution without moving the screw, to which it is coupled by a strong spiral spring, Fig. 24. Cylindrical recesses are formed in the opposing faces of the jaws to receive the hardened steel gripping dies, 111 and 112, which are made of various sizes and shapes to receive flat, square or round specimens. The forward half of these dies, 112, is made parallel and smooth, and of a shape to conform to the section of the specimen; following this the die, 111, has a series of alternate V-shaped ridges and grooves running transversely to the length of the specimen; the apex of the ridge next to the parallel die, 112, being truncated so that it stands a very little above the surface of the parallel die; the next ridge is truncated less and stands higher, and so on until the last ridge, which is left sharp, as shown in Fig. 26. The dies are closed upon the specimen to be tested by turning the worm wheel, which, by means of the abutment screw, 103, and crosshead, 106, pushes the jaws forward until the sharp ridge on the dies rests against the specimen; further revolution of the worm gear then winds up the spiral spring until the driving lugs on wheel and screw come in contact, when the sharp ridge is forced into the specimen sufficiently to insure that the friction beween the dies and the specimen shall be greater than that between the jaws and the case. When stress is applied to the specimen, the jaws will be drawn forward, sinking these ridges successively into the specimen until the parallel part of the dies grip it firmly, the idea being that the parallel part will hold with more than sufficient friction to compensate for the depression made in the specimen in the first ridge, and so on to the last, so that a bar of metal can be put into this holder without any preparation and broken without any risk of being broken in the gripped part.

As the jaws are drawn forward the spiral spring unwinds and keeps the abutment screw tightly pressed against the crosshead, holding it against the ends of the jaws, and taking up all lost motion, so that accurate centering and gripping of the specimen; freedom from tearing strains; accuracy of weighing at all times, definite weights applied at each movement, and great rapidity for commercial testing, are secured. When the specimen breaks it will in all cases be firmly held in the dies, and there will be no disturbance nor flying pieces, nor any noise beyond that of the broken piece itself.

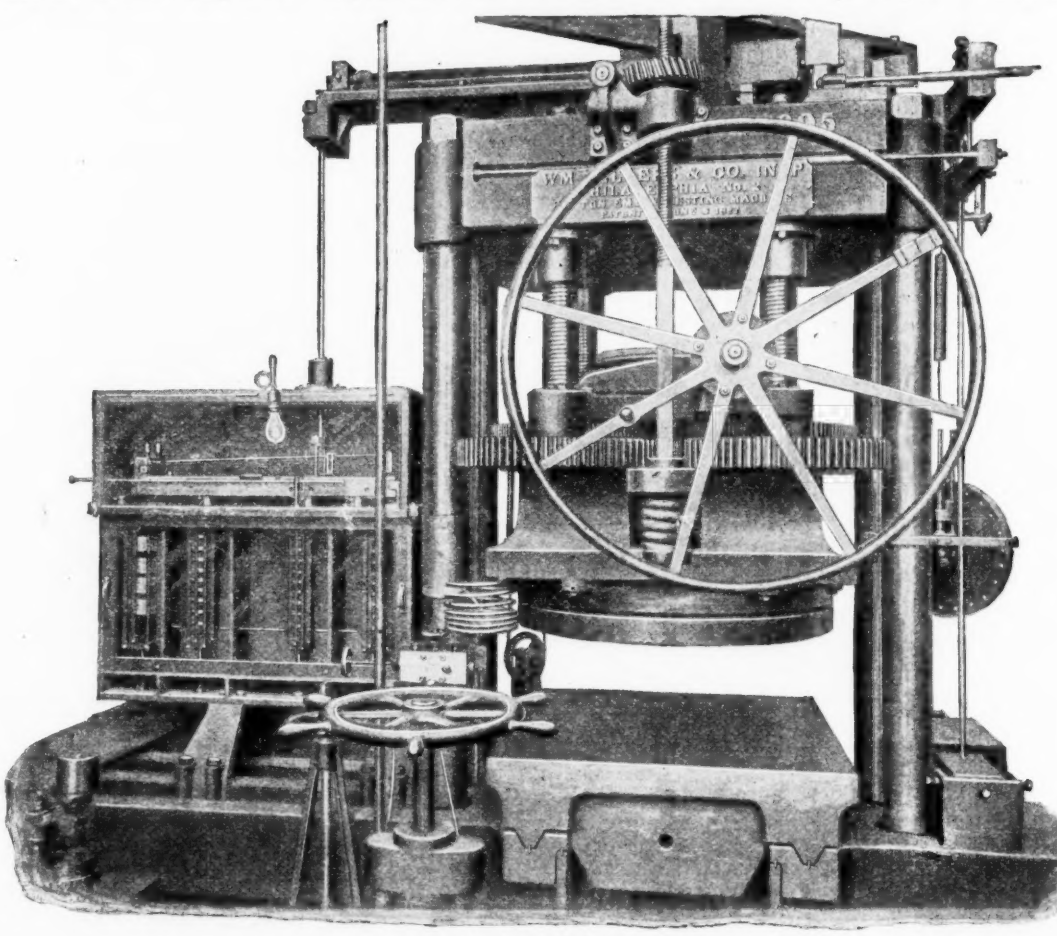

Fig. 36.

A description of the testing machine would not be complete without a notice of the support-testing machine by which all of these testing machines are rated.

This machine (Fig. 35) is made entirely of steel in order to secure the greatest possible rigidity and weighs some 45,000 pounds. It consists of a bed plate, 1, on which are mounted two main levers, 2, 2, which carry a heavy platform, 6, about 40 inches square; the outer ends of these levers are coupled to secondary levers, 3 and 4, also carried from the bed at their outer ends; the inner end of the lever, 3, is connected by a rod, 9, to a lever, 10, fulcrumed at the point, 12, to the top plate, 13, which is supported by four steel columns 5½ inches diameter and 77½ inches long from bed to top plate, 3½ inches diameter in plate. The lever, 10, on top is connected by a rod, 15, with the poise frame lever, 16, in the scale, from which lever all the poise frames are suspended and to which the indicator needle is connected; the second lever, 4, is connected by a rod, 9', to one end of the equal armed lever, 11, fulcrumed at the point, 14, to the top plate, 13, and at the point, 17, to the lever, 10, the lever, 11, serving to transfer the downward pull on the rod, 9', to the lever, 10, so as to have the same effect as the pull on the rod, 9. All of the supports and connections of all the levers are the Emery flexible fulcrum plates varying in thickness from about .005 inch at the needle to $\frac{5}{16}$ inch at the platform, which is designed to carry 500,000 pounds, and has carried 600,000 pounds without any signs of injury, the ratio from the platform to the point of the needle being 306,600 to 1. Close to the fulcrum of the second lever, 3, an auxiliary weighing platform, 18, having a capacity of 5,000 pounds is arranged and hung from the lever, 10. On the top plate is another platform, 19, of 500 pounds capacity. This large scale shows conclusively that the use of fulcrum plates instead of knife edges eliminates friction; a weight of 200 grains laid on the main platform puts in motion material weighing more than 25,000 pounds, and moves the needle .02 inch, and in all of our experimental work on this machine we were unable to perceive any reduction in this sensitiveness when fully loaded. The same weights are used for the three platforms, being decreased in value for the small platforms by the ratio that they bear to the main platform, thus a 1,000-pound weight in the scale balances one pound on the 500-pound platform, which turns with half a grain. Perspective engraving of the machine is shown at Fig. 36.

Pressure is applied to the platform of this scale by means of an upper platen, 8, movable by four large loading screws carried by nuts bolted to the top plate, by means of a large hand-wheel and worm gear. These screws are operated with the greatest nicety, so that the pressure upon any object resting on the scale platform can be adjusted exactly. The main hydraulic support of every testing machine built by us is placed on this platform and connected with the reducing chamber in the scale which is to be used with the machine. Definite loads are then applied by means of the loading screws, and the weights in the poise frames of the testing machine scale carefully adjusted to correspond; in this way every machine is rated accurately by small increments of load up to its full capacity, nothing being taken for granted. For very large machines, where the size of the annular hydraulic supports would be beyond the capacity of this machine, the supports are made circular and grouped around the draw bar, as before described, and by testing these supports first separately and then collectively, a testing machine of, for example, 10,000 tons capacity could be accurately rated throughout its full range, giving an absolute certainty as to results never before attained.

The original rating of this machine presented some very curious problems which gave a great deal of trouble to solve, but ended in convincing us that while the machine is exceedingly sensitive to change of load, it is also, which is a rare combination, equally insensitive to rough usage, such as severe side strains and twists.

The method of rating proposed was to place a standard weight on the platform and balance it by small standard weights placed in one of the poise frames; then to remove this standard and apply pressure to the platform by means of the loading screws until the small weights were again balanced; then to replace the standard and see if it was again balanced by the same amount of small weights, the weighing of the machine being assumed to be correct, if this standard weight would be balanced by the same small weights under all conditions of loading, and so on until the full capacity of the machine was reached.

The standard first used weighed a ton, and as the loads were applied by the screws its balancing weight fell off until it required only four-fifths of the small weights to balance it that it took when on the empty machine, in other words, it weighed but 1,600 pounds, and from that point on up to the full capacity of the scale, it weighed 1,600 pounds, neither more nor less. The first inference was that some part of the scale was not solidly fitted, and that under this load it settled to place. An initial load of 30,000 pounds was applied by steel bars placed so as to act as load springs but without producing any change in the action of the machine. The machine was then taken apart, but a very careful examination failed to detect any defect. Supposing that the defect might be too small to be readily discovered, an effort was made to exaggerate it, and so locate it by packing the lever supports out of level and in-wind; the machine required rebalancing, of course, but nothing that we did disturbed the action of the weight, nor the sensitiveness of the scale, nor the regularity of weighing when the critical point was once passed. The screws and gearing actuating the platen were then thought to be at fault, although it was impossible to see how they could cause any disturbance, but in order to avoid any question, an hydraulic chamber 3 feet in diameter was made and secured to the under side of the platen, and suspending bolts were provided so the platen could be adjusted closely to place by the screws and all lost motion taken up by the suspending bolts; pressure was applied by pumping liquid into this hydraulic chamber. The results differed in no way from those previously obtained, but by this time I had determined what the cause of the trouble was, namely, that we had been trying to weigh two kinds of pressure without thinking that they might have different results. I therefore coupled this hydraulic cylinder to a esting machine scale, applied a pressure of about 150,000 pounds on the platform of the support testing machine, and put weights on the poise frames of the testing machine scale until its needle stood at zero. We then ran the ton weight on, and, as I expected, the needle on the scale immediately moved, indicating a reduction in the pressure. This reduction was produced by the very minute sinking of the platform when the ton weight was applied; keeping the weight on, the screws were adjusted until the needle stood again at zero, and then the ton weight required exactly the same amount to balance it as when it was put on the empty machine. This settled the whole question; we found the machine was right, its weighings regular under conditions of distortion that would have ruined an ordinary scale and that the whole trouble came from the fact that we had been trying to weigh screw pressure and pressure produced by gravity without taking into account the disturbance that one produced on the other.

The extreme sensitiveness of this machine serves to show how material supposed to be solid and rigid is in reality continually in motion. In one test the full pressure of 500,000 pounds was put upon the platform and allowed to remain for 70 hours. At the end of this time it had fallen off to 498,407 pounds, and the falling off still continued at a rate of about one pound in 10 minutes. The pressure was then reduced to 400,000 pounds; instead of falling off the load increased 40 pounds in three minutes, and after standing for 10 minutes, the load decreased at the rate of 7 pounds in about five minutes. When the pressure was reduced to 300,000 pounds, in 9 minutes the load increased 146 pounds, with no further indication of increase or decrease for 11 minutes, when it began to fall off very slowly. The pressure was then reduced to 200,000 pounds. In 5 minutes it increased 307 pounds, and in 9 minutes 370 pounds. At this point the load began to fall off very slowly.

It would be very interesting to try if any lapse of time under load would finally bring these movements to rest, but there has been as yet no necessity for making the experiment.

At the conclusion the speaker was heartily applauded, and then answered some questions respecting the machine.

MR. HENRY R. TOWNE: I think it might assist the meeting and prevent a misunderstanding if a point made by Mr. Bancroft at the close of his remarks were explained—namely, that the experience with this machine had developed a difficulty due to the difference in pressures resulting from loads applied by gravity on one hand and the screws on the other. It was not clear to me what he meant by that, but he has cleared it up in a moment, and as others may have been as puzzled as I was, I think it may be interesting to have it explained. It is simply this, that the load applied upon the platform (Fig. 36), is applied through the action of the screws, producing tension in the stays or rods, and compression in other parts of the machine. Now, when a weight, say of one ton, is added to the load on the platen, it tends to substract that amount of load from the strain which is upon the other parts of the machine. It takes it from the tension of the rods, and off from the compression of

certain other parts, and it is that diminution of the pressure acting on the material of the machine which distributes the resistance of the material to that particular pressure. The pressure is lessened and the elastic action of the parts under the altered pressure is somewhat different from what it was before. The application of the additional load changes the tension (or the compression, as it may be) upon the component parts of the machine, and the means of recording that elasticity is so remarkable that it becomes apparent on the scale. Is that a correct statement?

Mr. Bancroft: Yes, sir. You can understand it probably better if you consider the machine instead of being supported on the base as being suspended on the upper crosshead. Then the columns would have the strain due to the weight of the machine, and also the pressure of the rigid blocks between the two platens. Assuming a ton weight put on the platform, it is clear you have thrown an additional stress on those bolts. They must elongate, and that elongation will diminish the pressure between the surfaces to the same extent.

Mr. Albert Emery: I would like to remark that I found the same thing in the original testing machine. . . I found that no load that I could put on those bolts, which were able to carry the 800,000 pounds load of the scale, would be retained on that scale perfectly any length of time. That is to say, whether I put 10,000 pounds on those bolts, or 100,000 pounds, or 20,000 pounds, or 500,000 pounds, it was immaterial. No load would stand still. They were always yielding, and I had to give up that method and take another one.

Mr. Towne: Mr. Emery was the first discoverer of the fact that there is no such thing as rigidity of material.

Mr. Emery: I would like to add to that remark another one. I have several times conceived the desirability of taking a single bar to form a measure of the stress put on the specimen, measuring the length of the bar when put under compression or tension by strain on the specimen, and recording that length very minutely. But the experience gained in testing this machine, as well as that formerly gained in the original machine, would indicate that the draw bar will never yield proportionately to the loads put on it. It will be subject to a very sensible and material error compared to any error of this machine.

Mr. C. E. Emery: The difficulty here is the simple one that we have in making the calculation as to the strain produced on a joint by the bolts. It has been said that after a bolt is strained it will not be further strained by pressure brought upon it from the interior of the cylinder, and at one time I made some experiments in which the spring and bolt were so proportioned that there did appear to be no difference whatever. But when discussing the matter with friends, and talking it over, it simply resolved itself into the plus and minus forces which we will get from two springs. We have the extension of the bolt, which has a certain rate; we have the thickness of the cover—the compression of the cover, I should have said, which is merely minus extension, and by taking their relative areas and their co-efficients of elasticity and comparing the two we find whether or not it is true that the pressure is greater to any considerable extent when applied after the bolt is already strained. There must always be a little more pressure under such circum stances at first, but with right proportions of the strut and of the bolt it lasts only for a moment, and after that the load brought by the pressure, of steam, for instance, simply takes up the other load and no additional strain is brought. That seems to be exactly the problem here. The application of the ton weight to the scale followed it up and showed its weight continuously. Just as soon as you put in a rod or anything which of itself stretched, it did not follow any longer, and the whole action had to be explained by combining with the weights shown by the scale, the elasticity of the springs, which also formed measuring instruments and were not included.

The balance of the time to adjournment was taken up by showing upon the screen and explaining many forms of testing machines formerly and at present used in this country and abroad; but there were so many of these as to make it impracticable to prepare and publish engravings of them in our columns.

A year or more since, an agent of a manufacturing concern succeeded in hiring a foreman and a considerable number of operatives in Germany to work in the factory, instructing them how to evade the law and land in this country. Recently the firm broke their contract with the operatives, and upon attempting to bring suit for the breach, the foreman found out that he could not do so, because the contract was an illegal one. The operatives are undoubtedly punished enough already, but there ought to be some way to reach the agent and the firm for which he acted.

In a paper on "Lubrication," read by Mr. H. Rawlings, before the Birmingham (England) Association of Engineers, the following conclusions were reached:

The best lubricants are the following for usual conditions met with in practice: Under very great pressure, with slow speed, graphite, soapstone, tallow, and other greases; under heavy pressure and high speed, sperm oil, castor oil, and heavy mineral oils; under light pressures and high speed, sperm, refined petroleum, olive, rape, and cotton seed; ordinary machines, lard oil, heavy minerals, and other vegetable oils; steam cylinders, heavy mineral oil.

What is probably the heaviest machine tool of its class ever constructed in Scotland has just been completed by Messrs. Crow, Harvey & Co., of Park Grove Iron Works, Kinning Park, Glasgow. It is a shearing machine for dealing with the heaviest boiler and ship shell and deck plating, and is capable of shearing steel in the cold state up to 2 inches in thickness and 6 feet 6 inches in width. The tool, which is driven by two 20-inch cylinder engines of 24 inch stroke, and geared up by steel gearing, is of 112 tons total weight, and has been manufactured for the new works of the Glasgow Iron and Steel Company, at Wishaw.—*The Engineer*, London.

A French scientist, M. Baudoin, maintains that water is held in the clouds by electricity, and that if this be discharged rain will fall. Hence he proposes to bring about rainfall by discharging it. It is said that experiments on a small scale, with kites, have been successful, and more extended experiments will be made by the aid of balloons.

A twin screw steamboat has been placed on Lake Titacaca, the highest navigable waters in the world, up in the mountains of Peru. The component parts of the boat, which is 170 feet long and 30 feet wide, were carried up the mountain on the backs of llamas and mules. The boat was built on the Clyde.

The *New York Recorder* prints two columns of accidents from trolley cars occurring during the month of February. How many got away is not known.

Manufactures.

The Mount Hope Iron Works, at Somerset, N. H., have started up.

The William Orrell Woolen-mill, at Glendale, R. I., have started up in full.

The E. P. Barrett Manufacturing Co., of Nashua, N. H., has been formed, with capital $250,000.

The A. L. Sayles & Co.'s Woolen-mill, at Pascoag, R. I., has been started after an idleness of several months.

The foundry of March Brownback Stove Co., Pottstown, Pa., has resumed operations, with a full force of hands.

It is said that the Johnstown (Pa.) Steel Works will be removed to Cleveland, and a $3,000,000 plant erected.

FOR ELECTRIC ELEVATORS.

A new device for throwing on and off the switch which is used in Electric Elevators and operated by the increase or decrease in the water pressure, is manufactured by the

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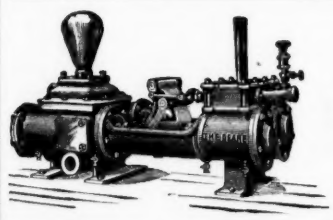

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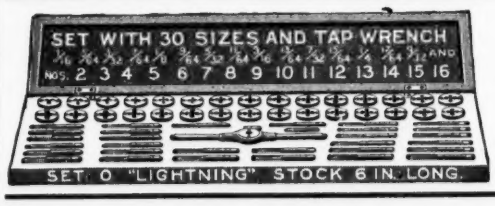

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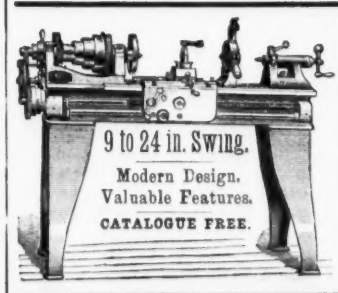

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The Lewis Foundry and Machine Co., of Pittsburgh, Pa., has secured a charter; the capital stock is placed at $200,000.

The Corey Needle Works, Manchester, N. H., which has been running but three and four days a week since fall, have started in on full time.

Owing to increase in orders the Tyrone (Pa.) Iron Works have resumed operations in full in every department after a long spell of idleness. The outlook for work is said to be very good.

Wiblin & Butts is the name of a new concern that has gone into the business of handling machinists' and manufacturers' supplies, at 197 W. Second street, Cincinnati, O.

De Witt Wire Cloth Co., 32 Reade street, New York, manufacturers of brass, copper, iron and steel wire cloth, wire ropes, sash wire, etc., has issued an 1894 illustrated price list.

Tinius Olsen & Co., Philadelphia, Pa., have issued an 1894 catalogue of testing machines, in which are illustrated and described the latest work of the firm in that class of machinery.

The Knowles Steam Pump Works, 93 Liberty street, New York, have issued a special catalogue of power pumps for paper and pulp mills. Some very fine specimens of pumps are shown in the catalogue.

The Phœnix Iron Works, Hartford, Conn., has started up, working ten hours a day. Since December the works have been very dull, many workmen have been laid off, and all have been on short time.

Dyer & Hughes' organ factory, at Foxcroft, Me., which has been running only eight hours per day since September 18th, began a short time ago to run nine hours, and the prospects are good for its running on full time soon.

The Electric Power Co. has been formed at Portland, Me., for the purpose of manufacturing electrical and mechanical motors, with $500,000 capital stock. The officers are: President, E. A. Clark; treasurer, E. C. Ramsdell.

Joshua Treat, one of Winterport's (Me.) enterprising citizens, will erect a steam mill there if the people will take stock to the amount of $5,000. Mr. Treat has had considerable business in that line, and has the machinery all purchased.

George Warrington, Chicago, Ill., issues a catalogue illustrating and describing the Warrington water-tube marine boiler, which he manufactures. These boilers are, we believe, more especially designed for use in steam launches, yachts, and moderately small craft.

Westinghouse, Church, Kerr & Co. announce the removal of their offices to Havemeyer Building, 26 Cortlandt street, New York, where they have a suite of four rooms, and are in every way better situated for their trade. They say that their business has been very good during the last six months.

W. D. Forbes & Co., machinists, Hoboken, N. J., imform us that they are finding a very marked improvement in business, being crowded to the extent that enlargement of works is contemplated.

Brown & Sharpe Mfg. Co write us March 15, 1894: We take pleasure in announcing that all departments of our machine shop are running full time—825 men, six days a week, and ten hours a day.

Another indication of reviving business in the machinery line is found in the fact that the Sterling Emery Wheel Co., of this city, have now in hand orders beyond the capacity of their two factories, both working full time. We have seen the orders, no small part of which are for export to foreign countries.

Sebastian Lathe Co., Cincinnati, O., write us March 14, 1894: Business still continues to improve, and inquiries are getting more numerous. We have recently been in receipt of quite a large number of inquiries from foreign countries, and we shall make an effort to increase our business in those parts, as well as at home.

The Lodge & Davis Machine Tool Co., of Cincinnati, O., have just received an order from Winklemann Bros., Valencia, Venezuela, South America, for several of their machine tools, including one large lathe 21 feet in length. They also have an order from Carlos Albert & Son, of the same place, for one of their improved shapers.

John Lang & Sons, Johnstone, near Glasgow, send us their 1894 illustrated catalogue of screw-cutting engine lathes from 12" to 36" swing; also various other machine tools. The lathes illustrated are all of the "gap" type so common in England and Scotland, and have the rigid clamp hold for tools, also common there. This is one of the leading firms of machine tool makers in Scotland.

The Calumet & Hecla Mining Co. have placed the order for a new iron building with The Berlin Iron Bridge Co., of East Berlin, Conn. The building will be 40 feet wide and 125 feet long, covered on the roof and sides with The Berlin Iron Bridge Company's patent anti-condensation corrugated iron. The iron work for the extension of the E. W. Bliss Co.'s foundry building at Brooklyn, N. Y., will be furnished by the same company.

An Angelica (N. Y.) correspondent writes: The C. N. Y. & W. R. R. will extend its line east from Wayland to Geneva, N. Y., and southwest from Angelica, N. Y., to Bolivar, N. Y., from which place they have a narrow-gauge line running to Olean, N. Y., that will be made standard, making a through line from Geneva to Olean. This road has been doing a fine business during these hard times. The repair shops will put on full number of hands April 1st. The heading mill of F. E. & J. M. Church, at Angelica, N. Y., is running night and day, and have a contract that will take until October next to fill. The superior quality of their goods makes a large demand for same, and large orders are turned away. This place is a fine location for a brush block factory, as there is an abundance of beech timber, which can be obtained at reasonable prices.

A Pittsburgh dispatch of March 12th to the *Evening Post* says: Signs of returning confidence in manufacturing circles continue. All the departments of the Cambria Iron Works, at Johnstown, which have been idle, resumed business this morning. The Johnson Steel Works, at the same place, also started up after an idleness of three months. About 2,000 men went to work for the two corporations. It is announced to-day that the Braddock Wire Works plant, at Rankin, near Pittsburgh, holds the record since Saturday, turning out more steel than any other single roll rod-mill in the world. The record has been held for a number of years by the Joliet (Ill.) Wire Works, whose rod-mill turned out 243 tons of wire rods in twelve hours. The output of the Braddock Works for Saturday, a turn of ten hours from 6 A. M. to 4 P. M., was 254 tons, breaking the record by eleven tons. A big run of steel was made every day last week, which indicates the receipt of large orders.

A. St. J. Newberry, assignee for The Lorain Manufacturing Co., Cleveland, Ohio, has issued the following: "In an article published in the Cleveland *Leader* on the morning of March 7, 1894, it is stated that The Lorain Company has been re-organized, its officers elected, and arrangements are now being made to start the works. This report is entirely premature. The plan stated in the article is under consideration by the stockholders of The Lorain Manufacturing Company, and has been approved by the holders of a majority of the stock. It has not yet, however, been finally

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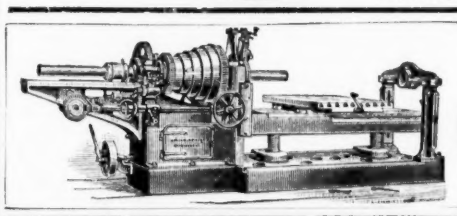

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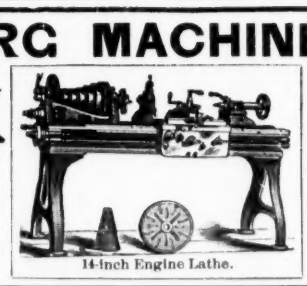
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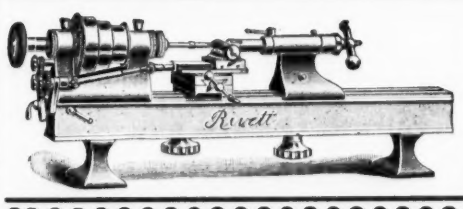

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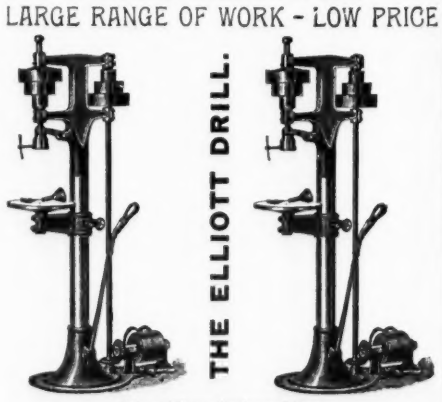

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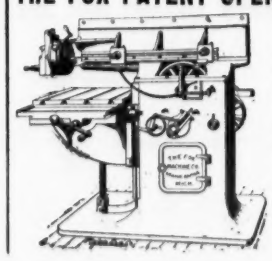

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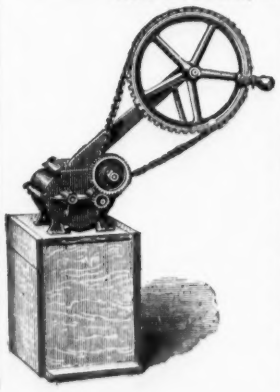

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agreed upon, and several details are yet unsettled. A majority of the stockholders have approved a plan providing for the raising of additional funds and the starting of the works, contingent upon obtaining a reasonable extension from the creditors of the company. It is hoped that this plan may be carried to success within a short time. The creditors will be advised as soon as definite sta tements can be made."

About 200 puddlers employed in the Cohoes (N.Y.) Rolling-mill who have been on a strike over a reduction of wages, amounting to fifteen per cent., have returned to work at the rates in vogue before the strike. This will also affect the employes in the Cohoes Tube Works.

Machinists' Supplies and Iron.

NEW YORK, March 17, 1894.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $13.00 to $14.00; No. 2, $12.50 to $13.25; Gray Forge, $11.75 to $12 50. Southern brands of good quality are obtainable at $13.00 to $14.00 for No. 1 Foundry; $11.75 to $12.50 for No. 2, and $10.75 to $11.25 for Gray Forge.

Antimony—The market is steady and quiet. We quote L. X., 9¼c. to 9⅜c.; Cookson's, 10c. to 10¼c.; Hallett's, 8¾c. to 9c., and U. S. French Star, 10c.

Lard Oil—Prime is quoted at 63c. to 64c.

Copper—The market is firmer, but the demand is light. Holders are reluctant to sell at the present prices and anticipate better rates in the near future. Lake Copper is quoted at 9.70c. to 9.80c. on spot. Casting Copper is held at 9¼c. to 9⅜c.

Lead—The market remains firm; there is little lead to be had; the quotations are 3⅜c. to 3.40c., and the official quotation is 3.20c. for bullion.

Spelter—The market is easy, 3.85c. to 3.90c. is asked for early New York delivery, but the demand is light.

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"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

An experienced foreman patternmaker wants sit'n; highest refs. as to ability. Patterns, AM. MACH

Patternmaker wishes pos, good capable workman. Address Box 184, AMERICAN MACHINIST.

Mechanical draftsman, Swede, wants position. Box 35, AMERICAN MACHINIST.

Mech. eng. and draftsman; tech. grad., exp'd in rolling mill work and steam engineering, desires situation. Address Box 36, AMERICAN MACHINIST.

Foreman patternmaker, desirous of making a change, well up in bridge, roofing and architectural work. Address 435, AMERICAN MACHINIST.

Wanted—Position as foreman of foundry by a man who thoroughly understands his business. Address X. Y. Z., 397 Ontario street, Cleveland, O.

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First-class tool maker, experienced on dies, hardening, case-hardening, moderate wages, distance no object, wants position. N. Y., AM. MACH.

First-class molder desires situation, dry or green sand, temperate. New England or New York preferred. Address BOX 39, AM. MACHINIST.

Wanted—A machine shop foreman accustomed to press and die work. State age, exp., and salary wanted. Address, with refs., "Manufacturer," care Prentiss Tool & Supply Co., 115 Liberty St. N.Y.

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Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S.M.York, Clev'd, O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

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Wanted—Modern compound slow speed engine 150 to 200 horse-power. Address Box 41, AM. MACH.

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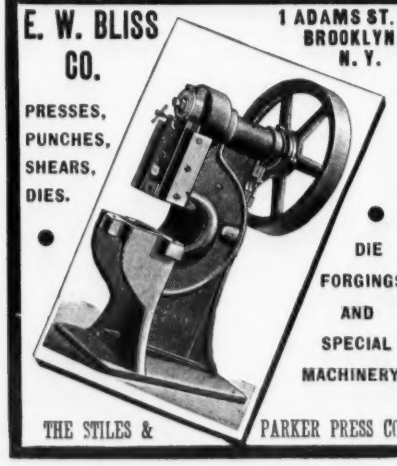
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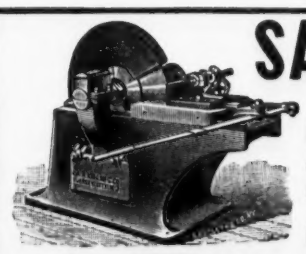
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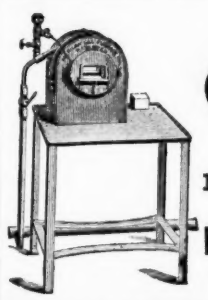
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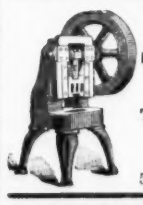
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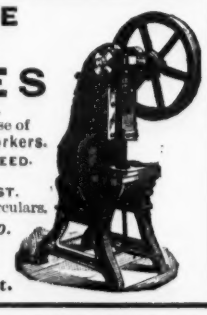

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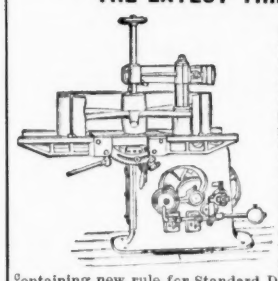
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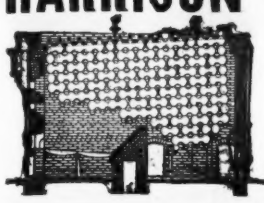

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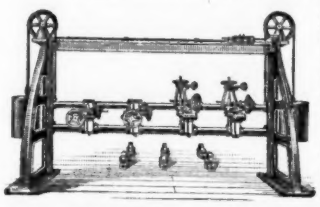

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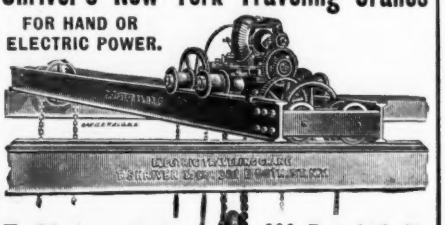

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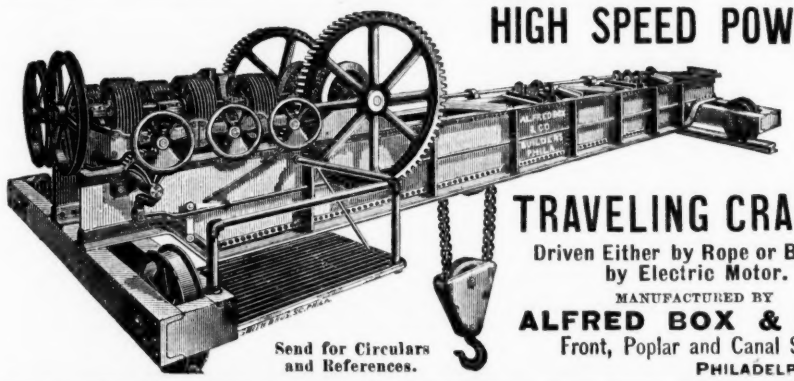

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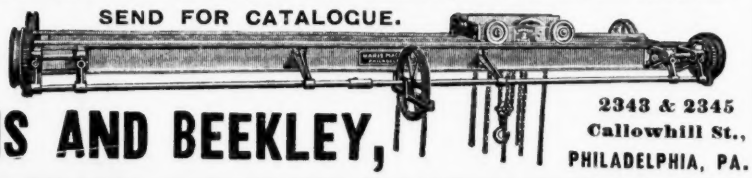

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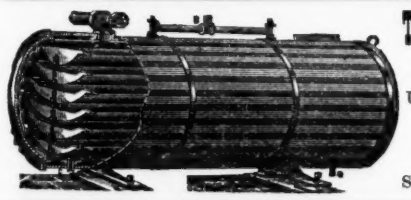

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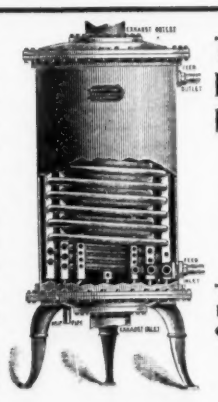

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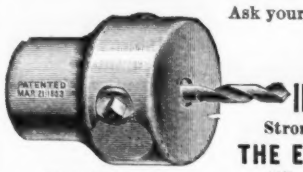

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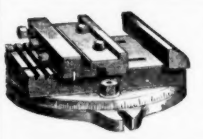

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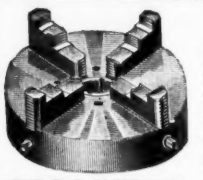

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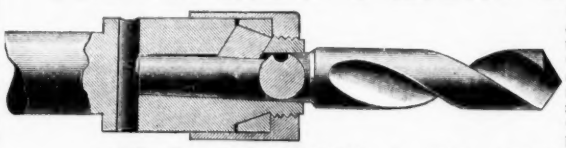

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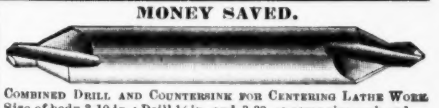

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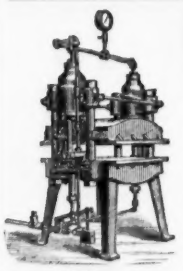

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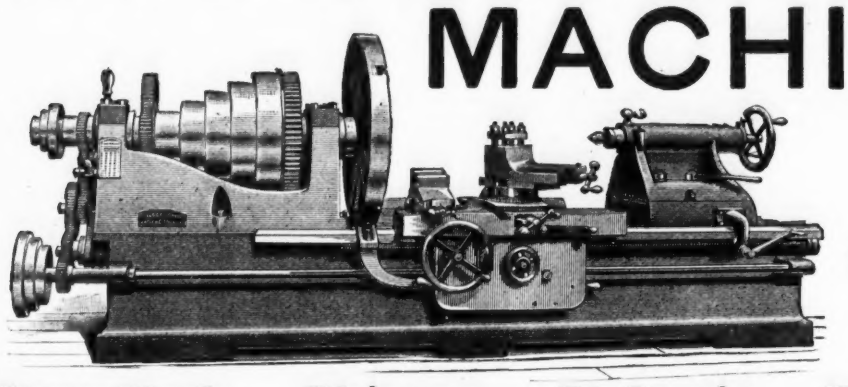

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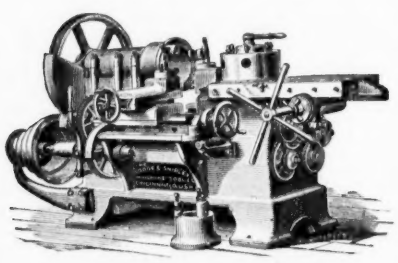

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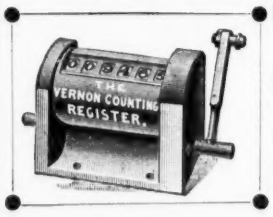

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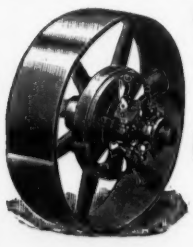

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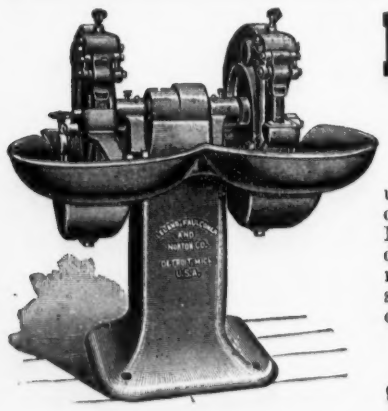

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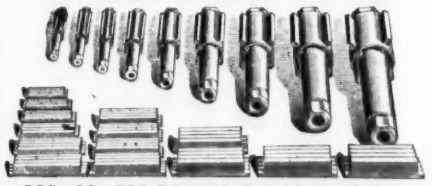

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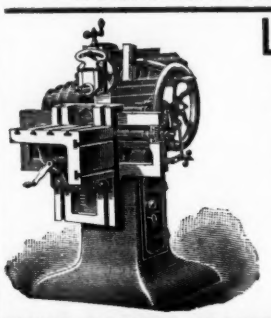

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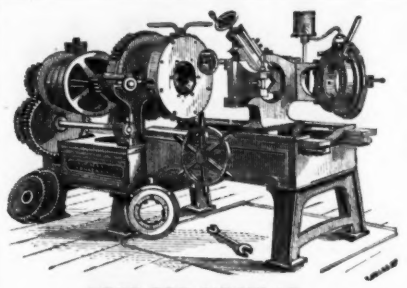

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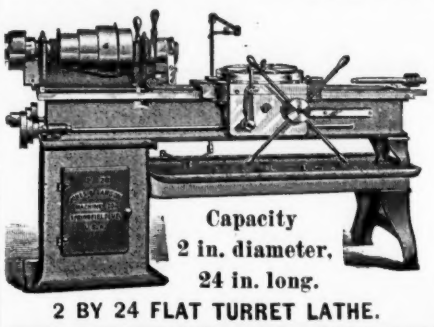

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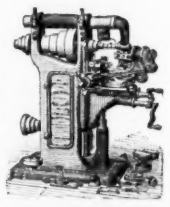

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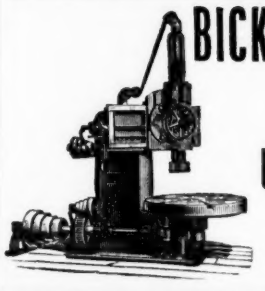

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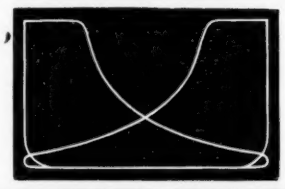

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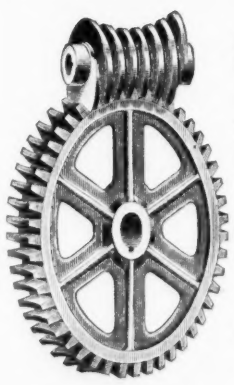

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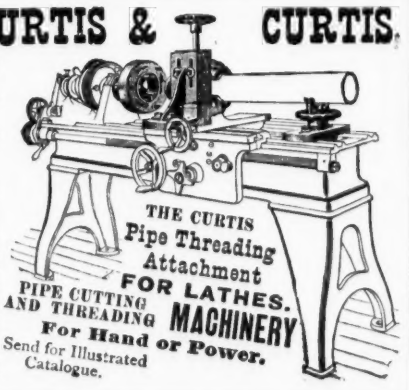

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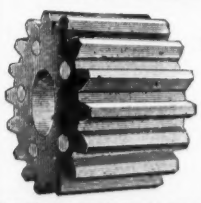

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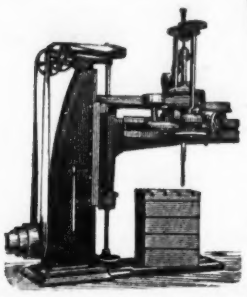

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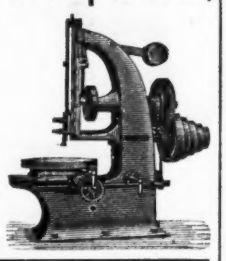

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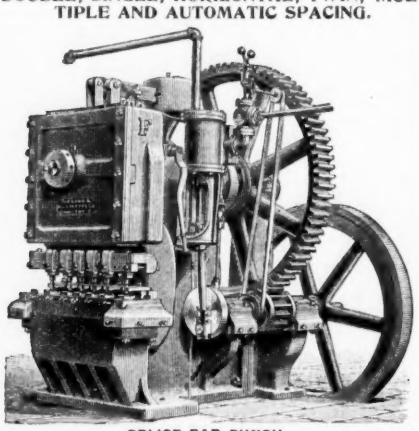

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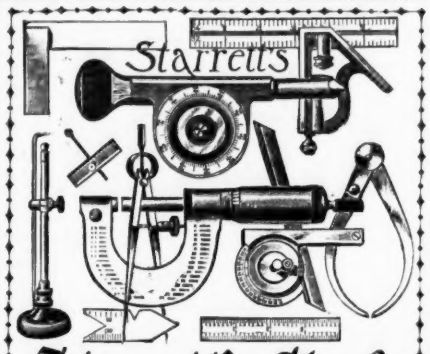

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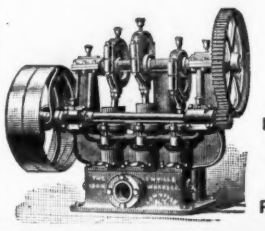

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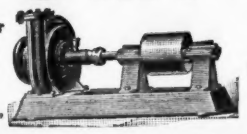

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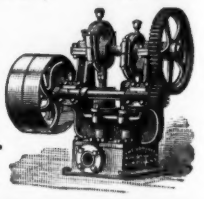

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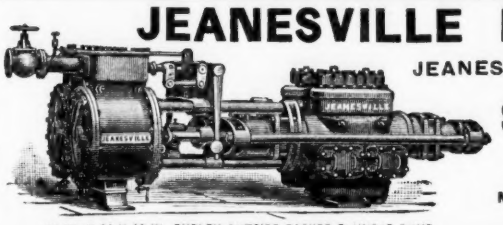

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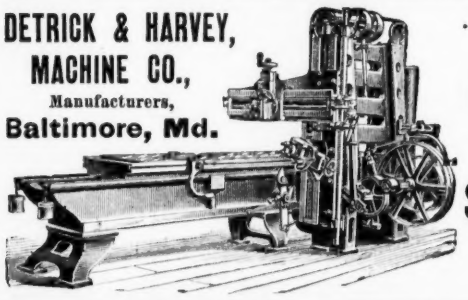

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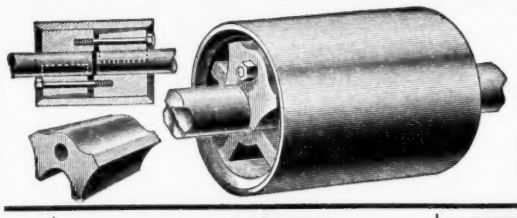

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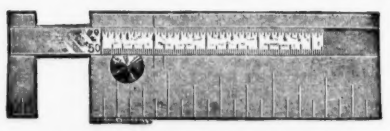

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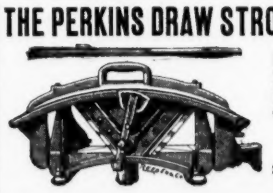

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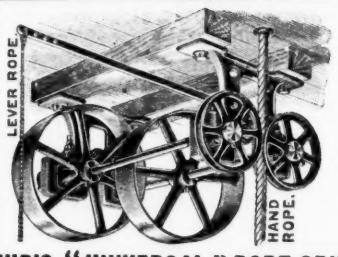

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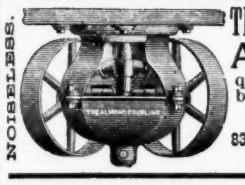

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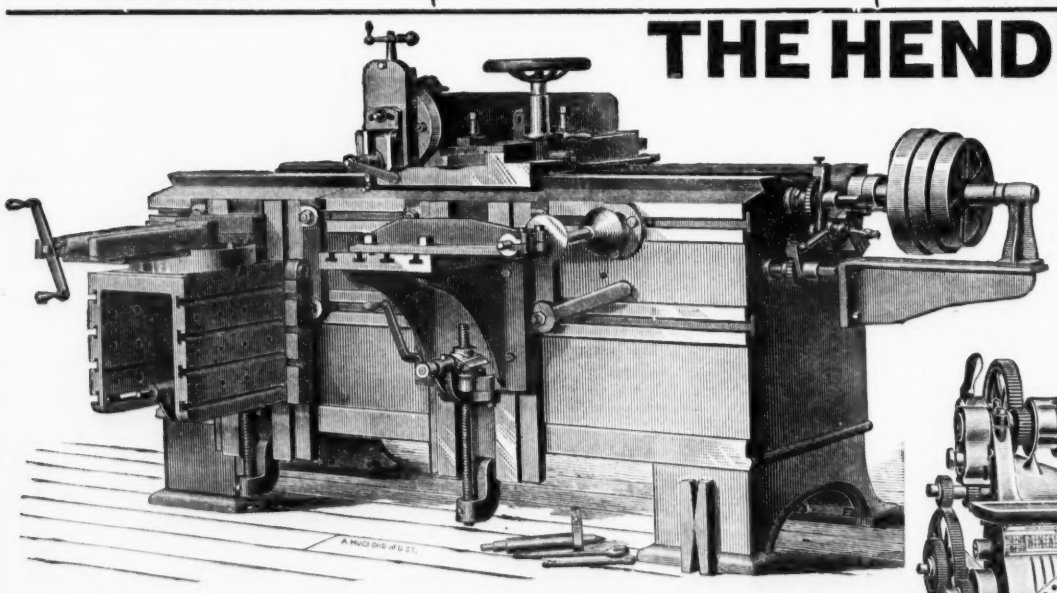

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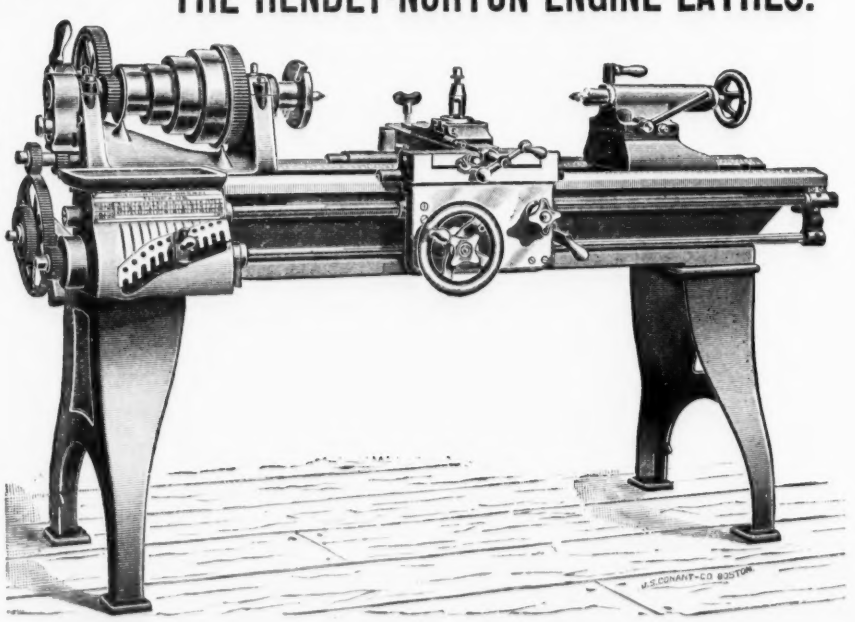

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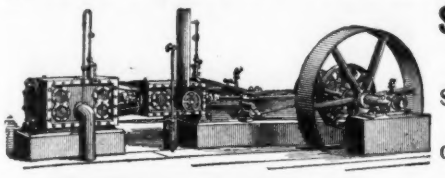

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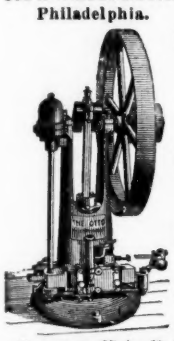

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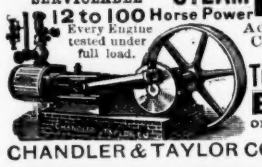

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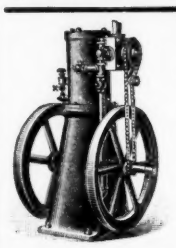

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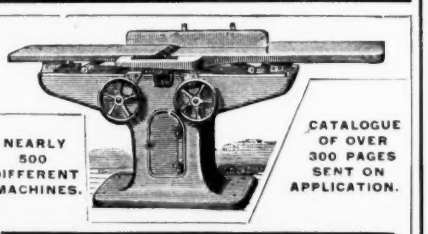

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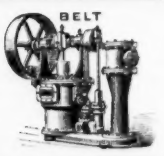

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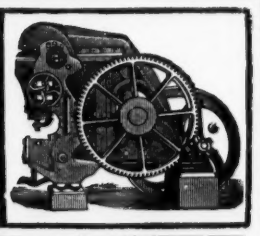

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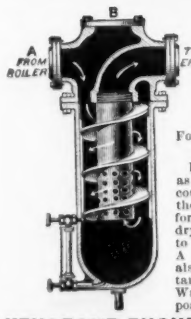

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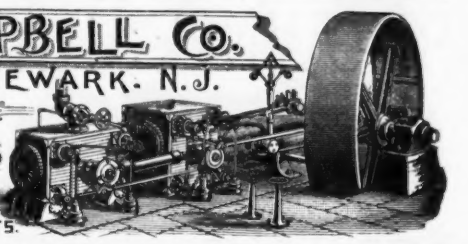

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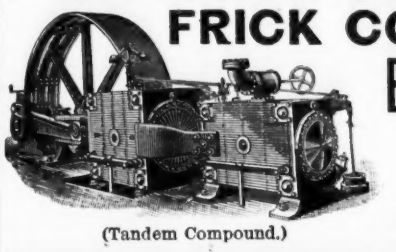

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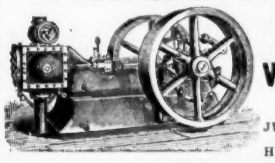

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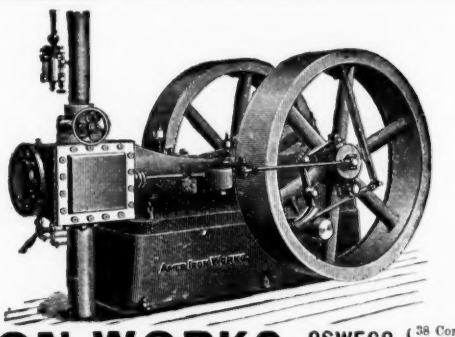

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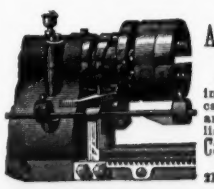

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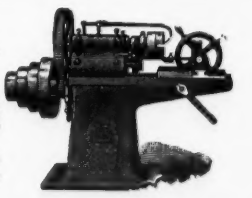

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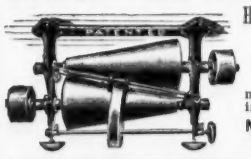

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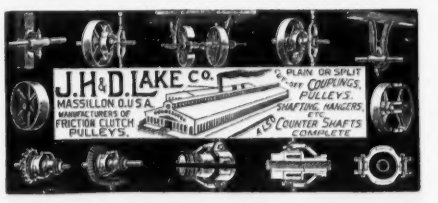
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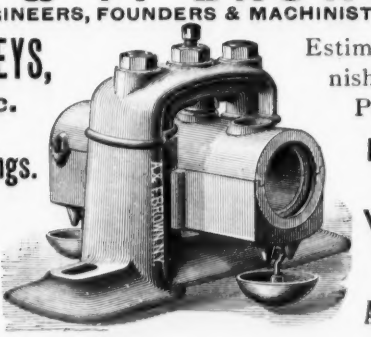

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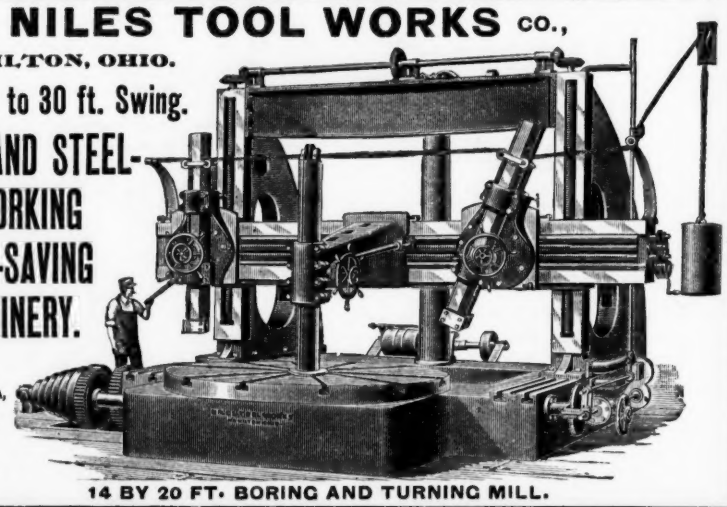

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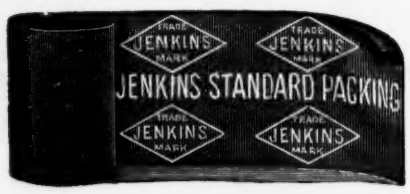

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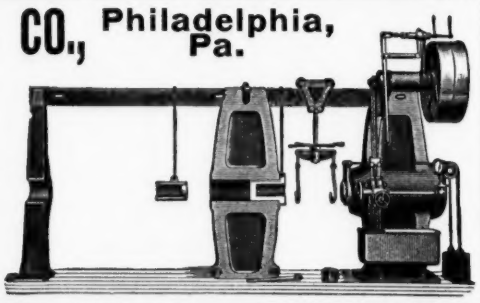

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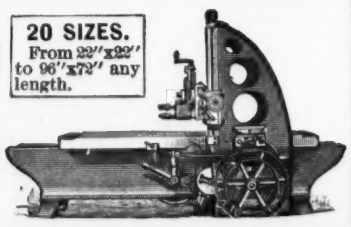

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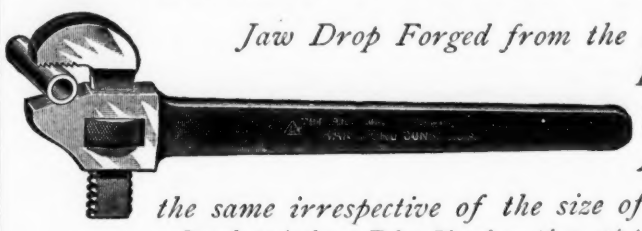

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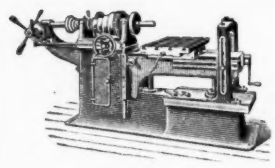

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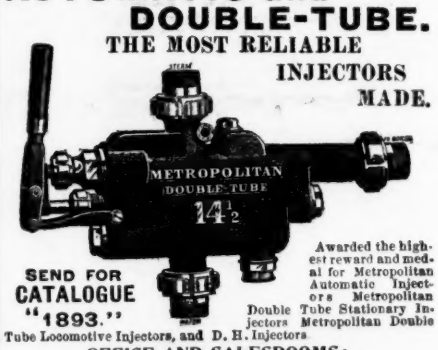

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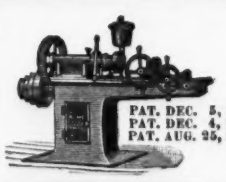

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